TECHNICAL MANUAL

***Sigma*® CD IOT Transmitters**

I Introduction
II Installation & Checkout
III Operation
IV Theory of Operation
V Maintenance & Alignments
V I Troubleshooting
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VIII Subsections

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Returns And Exchanges

Damaged or undamaged equipment should not be returned unless written approval and a Return Authorization is received from HARRIS CORPORATION, Broadcast Systems Division. Special shipping instructions and coding will be provided to assure proper handling. Complete details regarding circumstances and reasons for return are to be included in the request for return. Custom equipment or special order equipment is not returnable. In those instances where return or exchange of equipment is at the request of the customer, or convenience of the customer, a restocking fee will be charged. All returns will be sent freight prepaid and properly insured by the customer. When communicating with HARRIS CORPORATION, Broadcast Division, specify the HARRIS Order Number or Invoice Number.

Unpacking

Carefully unpack the equipment and preform a visual inspection to determine that no apparent damage was incurred during shipment. Retain the shipping materials until it has been determined that all received equipment is not damaged. Locate and retain all PACKING CHECK LISTs. Use the PACKING CHECK LIST to help locate and identify any components or assemblies which are removed for shipping and must be reinstalled. Also remove any shipping supports, straps, and packing materials prior to initial turn on.

Technical Assistance

HARRIS Technical and Troubleshooting assistance is available from HARRIS Field Service during normal business hours (8:00 AM - 5:00 PM Central Time). Emergency service is available 24 hours a day. Telephone 217/222-8200 to contact the Field Service Department or address correspondence to Field Service Department, HARRIS CORPORATION, Broadcast Systems Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a FAX facility (217/222-7041) or a TELEX service (650/372-2976).

Replaceable Parts Service

Replacement parts are available 24 hours a day, seven days a week from the HARRIS Service Parts Department. Telephone 217/222-8200 to contact the service parts department or address correspondence to Service Parts Department, HARRIS CORPORATION, Broadcast Systems Division, P.O. Box 4290, Quincy, Illinois 62305-4290, USA. The HARRIS factory may also be contacted through a FAX facility (217/222-7041) or a TELEX service (650/372-2976).

NOTE

The # symbol used in the parts list means used with (e.g. #C001 = used with C001).

WARNING

THE CURRENTS AND VOLTAGES IN THIS EQUIPMENT ARE DANGEROUS. PERSONNEL MUST AT ALL TIMES OBSERVE SAFETY WARNINGS, INSTRUCTIONS AND REGULATIONS.

This manual is intended as a general guide for trained and qualified personnel who are aware of the dangers inherent in handling potentially hazardous electrical/electronic circuits. It is not intended to contain a complete statement of all safety precautions which should be observed by personnel in using this or other electronic equipment.

The installation, operation, maintenance and service of this equipment involves risks both to personnel and equipment, and must be performed only by qualified personnel exercising due care. HARRIS CORPORATION shall not be responsible for injury or damage resulting from improper procedures or from the use of improperly trained or inexperienced personnel performing such tasks.

During installation and operation of this equipment, local building codes and fire protection standards must be observed. The following National Fire Protection Association (NFPA) standards are recommended as reference:

- Automatic Fire Detectors, No. 72E
- Installation, Maintenance, and Use of Portable Fire Extinguishers, No. 10
- Halogenated Fire Extinguishing Agent Systems, No. 12A

WARNING

ALWAYS DISCONNECT POWER BEFORE OPENING COVERS, DOORS, ENCLOSURES, GATES, PANELS OR SHIELDS. ALWAYS USE GROUNDING STICKS AND SHORT OUT HIGH VOLTAGE POINTS BEFORE SERVICING. NEVER MAKE INTERNAL ADJUSTMENTS, PERFORM MAINTENANCE OR SERVICE WHEN ALONE OR WHEN FATIGUED.

Do not remove, short-circuit or tamper with interlock switches on access covers, doors, enclosures, gates, panels or shields. Keep away from live circuits, know your equipment and don't take chances.

WARNING

IN CASE OF EMERGENCY ENSURE THAT POWER HAS BEEN DISCONNECTED.

WARNING

IF OIL FILLED OR ELECTROLYTIC CAPACITORS ARE UTILIZED IN YOUR EQUIPMENT, AND IF A LEAK OR BULGE IS APPARENT ON THE CAPACITOR CASE WHEN THE UNIT IS OPENED FOR SERVICE OR MAINTENANCE, ALLOW THE UNIT TO COOL DOWN BEFORE ATTEMPTING TO REMOVE THE DEFECTIVE CAPACITOR. DO NOT ATTEMPT TO SERVICE A DEFECTIVE CAPACITOR WHILE IT IS HOT DUE TO THE POSSIBILITY OF A CASE RUPTURE AND SUBSEQUENT INJURY.

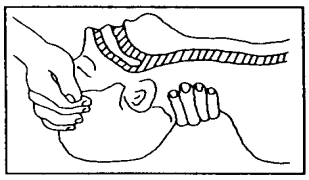
TREATMENT OF ELECTRICAL SHOCK

1. IF VICTIM IS NOT RESPONSIVE FOLLOW THE A-B-CS OF BASIC LIFE SUPPORT.

PLACE VICTIM FLAT ON HIS BACK ON A HARD SURFACE

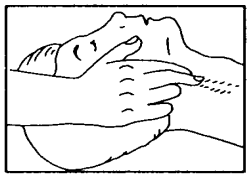
(A) AIRWAY

IF UNCONSCIOUS,
OPEN AIRWAY



LIFT UP NECK
PUSH FOREHEAD BACK
CLEAR OUT MOUTH IF NECESSARY
OBSERVE FOR BREATHING

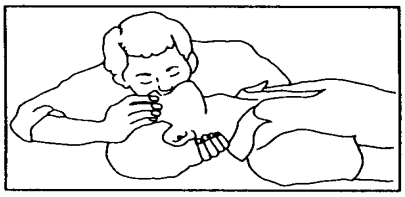
CHECK
CAROTID PULSE



IF PULSE ABSENT,
BEGIN ARTIFICIAL
CIRCULATION

(B) BREATHING

IF NOT BREATHING,
BEGIN ARTIFICIAL BREATHING

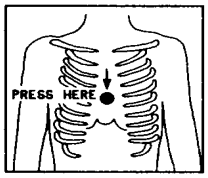


TILT HEAD
PINCH NOSTRILS
MAKE AIRTIGHT SEAL
4 QUICK FULL BREATHS

REMEMBER MOUTH TO MOUTH
RESUSCITATION MUST BE
COMMENCED AS SOON AS POSSIBLE

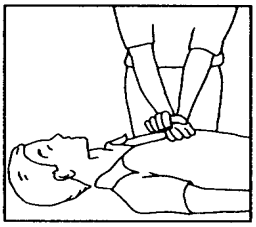
(C) CIRCULATION

DEPRESS STERNUM 1 1/2 TO 2 INCHES



APPROX. RATE OF COMPRESSIONS --80 PER MINUTE
- ONE RESCUER
- 15 COMPRESSIONS
- 2 QUICK BREATHS

APPROX. RATE OF COMPRESSIONS --60 PER MINUTE
- TWO RESCUERS
- 5 COMPRESSIONS
- 1 BREATH



NOTE: DO NOT INTERRUPT RHYTHM OF COMPRESSIONS WHEN SECOND PERSON IS GIVING BREATH

CALL FOR MEDICAL ASSISTANCE AS SOON AS POSSIBLE.

2. IF VICTIM IS RESPONSIVE.

A. KEEP THEM WARM
B. KEEP THEM AS QUIET AS POSSIBLE
C. LOOSEN THEIR CLOTHING
D. A RECLINING POSITION IS RECOMMENDED

WARNING: Disconnect primary power prior to servicing.

FIRST-AID

Personnel engaged in the installation, operation, maintenance or servicing of this equipment are urged to become familiar with first-aid theory and practices. The following information is not intended to be complete first-aid procedures, it is a brief and is only to be used as a reference. It is the duty of all personnel using the equipment to be prepared to give adequate Emergency First Aid and thereby prevent avoidable loss of life.

Treatment of Electrical Burns

1. Extensive burned and broken skin
   a. Cover area with clean sheet or cloth. (Cleanest available cloth article.)
   b. Do not break blisters, remove tissue, remove adhered particles of clothing, or apply any salve or ointment.
   c. Treat victim for shock as required.
   d. Arrange transportation to a hospital as quickly as possible.
   e. If arms or legs are affected keep them elevated.

NOTE

If medical help will not be available within an hour and the victim is conscious and not vomiting, give him a weak solution of salt and soda: 1 level teaspoonful of salt and 1/2 level teaspoonful of baking soda to each quart of water (neither hot or cold). Allow victim to sip slowly about 4 ounces (a half of glass) over a period of 15 minutes. Discontinue fluid if vomiting occurs. (Do not give alcohol.)

2. Less severe burns - (1st & 2nd degree)
   a. Apply cool (not ice cold) compresses using the cleanest available cloth article.
   b. Do not break blisters, remove tissue, remove adhered particles of clothing, or apply salve or ointment.
   c. Apply clean dry dressing if necessary.
   d. Treat victim for shock as required.
   e. Arrange transportation to a hospital as quickly as possible.
   f. If arms or legs are affected keep them elevated.

REFERENCE:

ILLINOIS HEART ASSOCIATION

AMERICAN RED CROSS STANDARD FIRST AID AND PERSONAL SAFETY MANUAL (SECOND EDITION)

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WARNING: Disconnect primary power prior to servicing.

1.1 Scope and Purpose

This technical manual contains information necessary to install and maintain the **Sigma® CD** Transmitter. This includes the following:

- Control cabinet
- Amplifier cabinet
- Line control cabinet
- Cooling system/pump module
- Optional dry high voltage power supply

A **separate drawing package** for the above transmitter and internal assemblies is supplied by Harris.

Harris will also supply separate technical manuals for the **CD 1A™ exciter, exciter switcher**, and **RF** systems (schematic drawings for the exciter switcher and RF systems are located in their respective manuals).

Information on the RF systems (balanced intermod filter and RF switching components), Break-away/harmonic filter and high voltage power supply will be supplied by the respective vendor companies.

The tube vendor will supply assembly instructions and factory test data with each tube.

1.2 General Description

This section provides a general description for the transmitter and associated components.

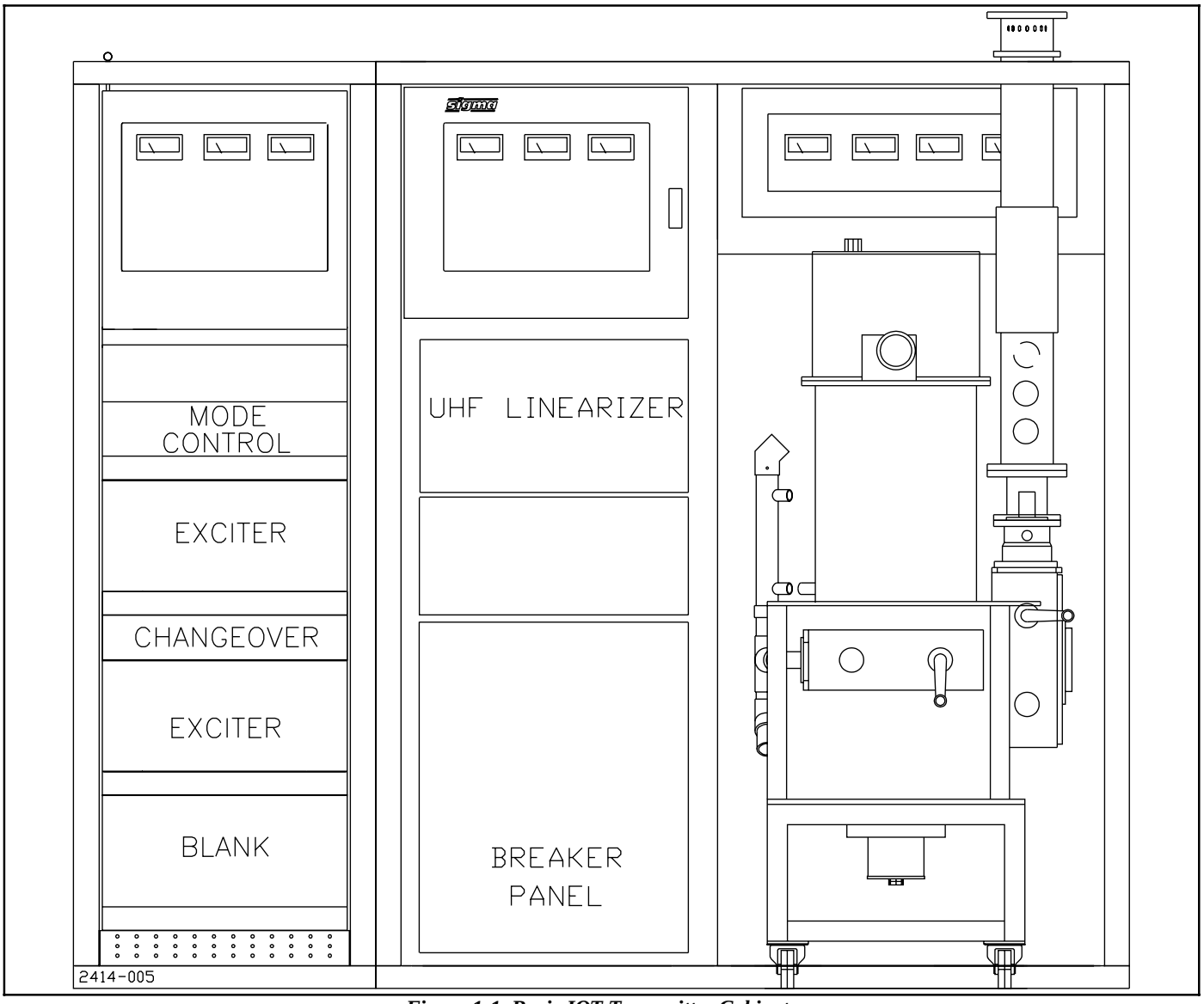


Figure 1-1. Basic IOT Transmitter Cabinets

WARNING: Disconnect primary power prior to servicing.

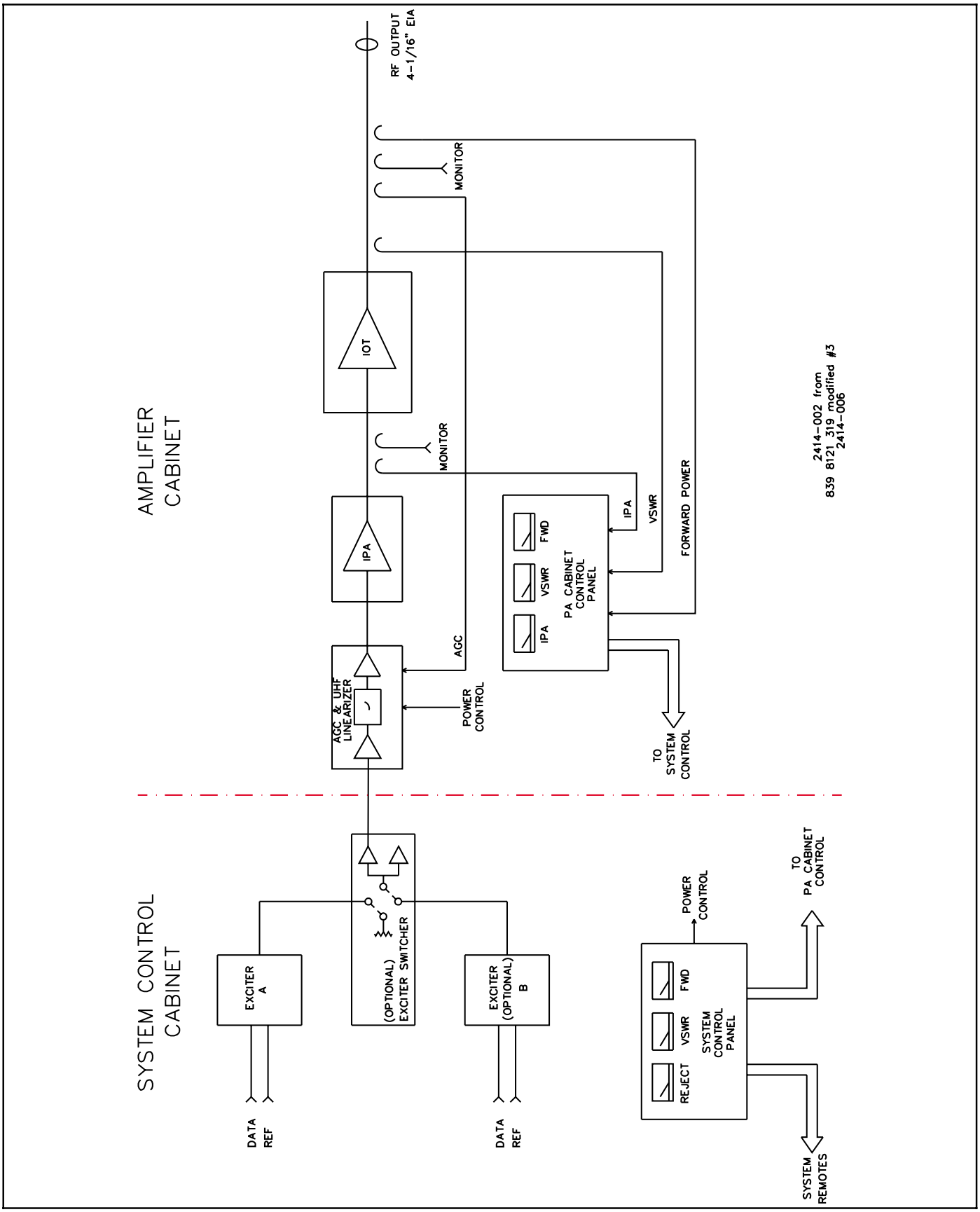


Figure 1-2. Single IOT Block Diagram

WARNING: Disconnect primary power prior to servicing.

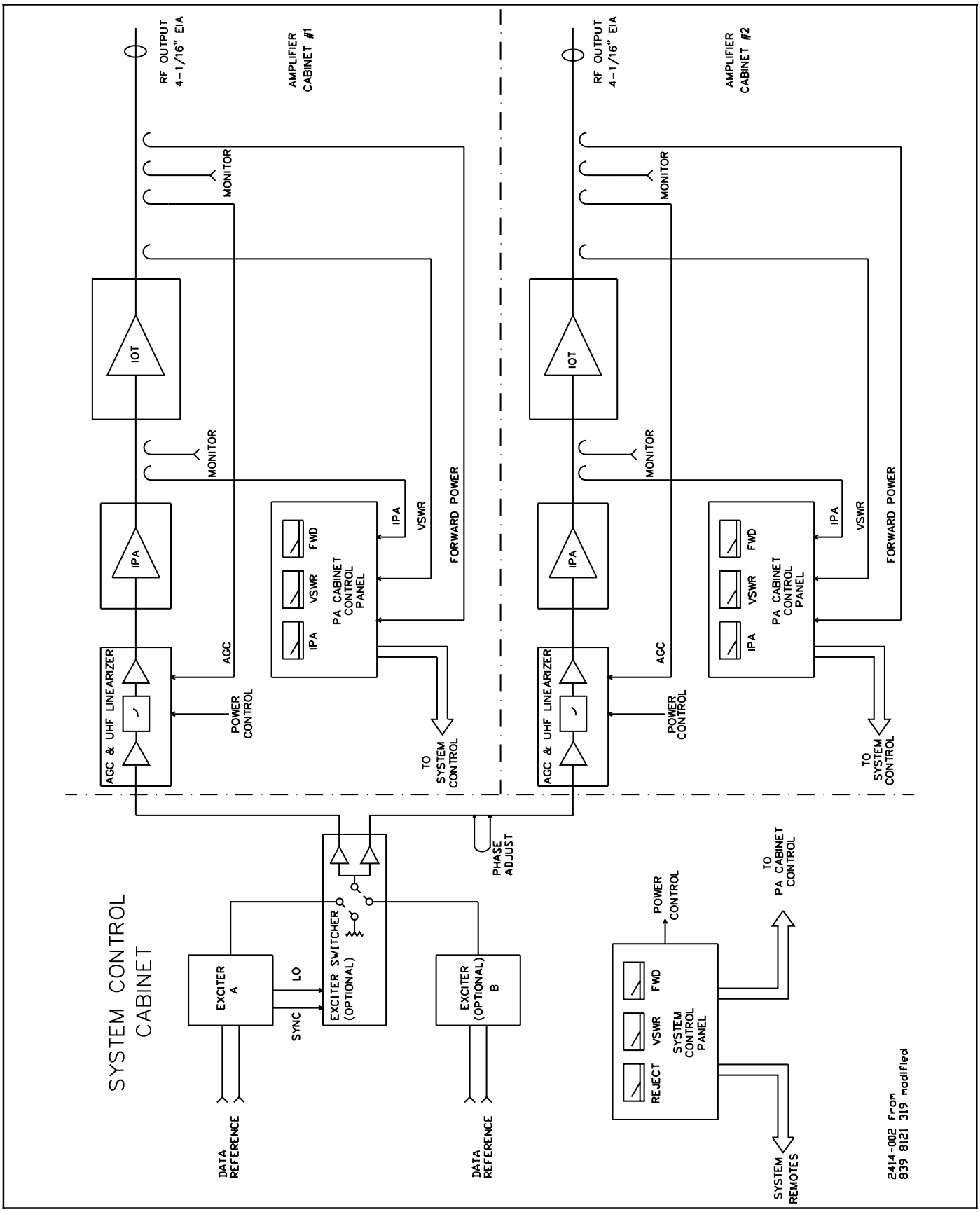


Figure 1-3. Multiple IOT Block Diagram

WARNING: Disconnect primary power prior to servicing.

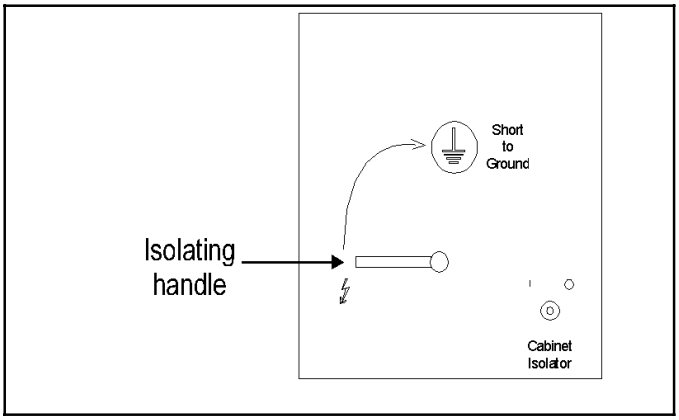
1.2.1 Transmitter Cabinets

The **SigmaCD™** transmitters include a single exciter/control cabinet and one or more power amplifier cabinets, depending on power level and configuration. The control cabinet houses one (or optionally two) **CD 1A™** exciter(s), optional exciter switcher, mode controller (for 2 or more PA cabinets), the system control logic, system interface board, and dc power supplies.

The power amplifier cabinet(s) (PA) contain the AGC & UHF linearizer, IPA stage, feed forward correction circuitry, the IOT assembly, thyratron crowbar assembly, isolated power supplies (focus, ion, bias), cooling fans, and the amplifier control logic and supplies. Each PA cabinet is identical and can operate independently of the other PA cabinets.

CAUTION

ISOLATE THE AMPLIFIER AT THE INTERLOCK AND EARTHING SWITCH PANEL LOCATED ON THE REAR PANEL OF THE CABINET AND LOCK OUT THE BREAKERS AT THE LINE CONTROL CABINET. BEFORE DISCONNECTING OR SERVICING ANY COMPONENTS LOCATED IN THIS AREA.



Switch Off Sequence

1.2.2 Beam Supplies

Refer to vendor manual supplied with the unit.

Each PA cabinet has its own high voltage beam power supply. This is an oil-filled outdoor unit with provisions for output voltage selection. Associated with each beam power supply is an ac line control cabinet. The line control cabinet provides the ac distribution for each PA cabinet and includes the step-start circuit that applies ac to the high voltage beam supply in two steps. The purpose of the step start sequence is to limit the beam supply initial inrush current.

1.2.3 Optional Dry High Voltage Supplies

Where required, optional dry, air cooled indoor high voltage beam supplies are available. These supplies are controlled by the line control cabinets in the same manner as the oil filled beam supplies.

1.2.4 Cooling

A single stage, self contained, open loop water/glycol system is provided for liquid cooled IOT versions.

The water/glycol mixture prevents freeze damage during operation in cold climates. A 50% glycol ratio is required to provide the proper dielectric for water column load. For warm climates, an optional closed loop water system is available. Resistive test loads will be provided for use with water only systems. Dual pumps and outdoor fan/coil units with multiple fans are standard equipment.

Heat exchangers are sized to cool the transmitter and all system reject/test loads under full operating power conditions.

Each PA cabinet has internal air cooling for the IOT cavities and IPA.

1.2.5 System Control Panel

The control panel provides overall operating controls for a complete transmitter system. A typical transmitter system contains one control cabinet and one to four PA cabinets. On the system control panel, an LED below each control switch will light when its switch is pressed. If all amplifier states do not agree with the selection, the system control panel LED that agrees with the alternate amplifier state (amplifier with a different state) will be on or flash, depending on jumper selection. In the amplifier cabinet control panel where the unequal state exists, the LED that represents the actual state of that amplifier will be lit, and the LED that represents the state of the system control panel will be off or flash, depending on jumper selection. An amplifier cabinet can be in a different state from the system control panel because it is in local (not remote) control, locked out due to a fault, or disabled.

The system control panel provides metering of overall transmitter output power, VSWR, reject power, power raise/lower control, and fault status reporting. Operational status controls include LOCAL/REMOTE, OFF, BKHEAT, STANDBY, and BEAM.

The system control board has remote control inputs for OFF, BKHEAT, STANDBY, BEAM, RESET and POWER RAISE and POWER LOWER via connector X6 on the system control PCB. Remote system status monitoring outputs are are available from connectors X5 and X6 on the system interface PCB. Remote system analog outputs are are available from connector X15 on the system interface PCB.

Each amplifier has indication for output power normal, ready, and amplifier normal. If one or more of these are off, the cabinets ready LED on the system/amplifier control panel can be off or flashing, depending on jumper position.

System status LED indicators are provided for normal, ready and output power. Normal status indicators are green. Fault status indicators are red and provide the following information:

- AMPLIFIER lockout
- EXCITER status
- A (upper) RF level/data
- B (lower) RF level/data

WARNING: Disconnect primary power prior to servicing.

- System VSWR
- Reject power.

Up to 3 reject load circuits may be monitored, in order to accommodate the largest transmitter configuration. Monitoring selection is made by pressing a tactile push-button switch. A green LED indicates the which reject load is selected.

1.2.6 CD 1A™ Exciter

Complete information on the **Sigma® CD 1A™** exciter assembly is supplied separately as a service manual. The basic functions only are being discussed in the following paragraphs.

1.2.6.1 General Description

The Harris CD 1A™ exciter converts the digital input signal received from the ATSC transport layer to an RF signal on the operating channel. The ATSC transport layer signal may be from an encoder near the transmitter, or from a studio located elsewhere, delivered by microwave or other means.

The CD 1A™ exciter accommodates a SMPTE 310M format transport signal with an embedded clock.

The exciter processes this input into the on-channel 8VSB signal needed as drive for the transmitter amplifiers. Correction circuits in the exciter pre-distort linearity, phase, response and delay to compensate for errors which occur in the amplifiers, resulting in a low-distortion output signal from the transmitter with very low intermodulation products.

1.2.7 Exciter Switcher (Refer to Technical Manual 988-2426-001)

Complete information on the **Sigma® CD** exciter switcher assembly is supplied separately as a service manual. Only the basic functions are discussed in the following paragraphs.

The exciter switcher is housed in a rack mount chassis, which is installed in the control cabinet, along with the exciters. Signal outputs from both exciters are connected to the switcher and one exciter's output is selected and sent to the transmitter. Output from the reserve exciter is terminated in the exciter switcher.

Fault detection circuits in the exciter switcher monitor the fault signals from both exciters. Front panel indicator lights on the switcher signal fault conditions.

A front panel ON AIR EXCITER SELECT switch allows an operator to change exciters. An AUTO/MANUAL SELECT switch permits the operator to choose whether exciter selection is by manual or automatic operation. When in automatic operation, the exciter switcher changes exciters when a fault occurs in the selected exciter.

A remote control switch may be used to enable or disable control of the exciter switcher by controls located away from the transmitter.

1.2.8 Amplifier Control

Refer to Figure 1-5 System diagram.

Amplifier controls are provided for LOCAL, OFF, BK HEAT, STANDBY, BEAM, RESET DISPLAY, and RESET LOCKOUT.

Normal status indicators are green LEDs, and indication is provided for AC PRESENT, INTERNAL INTERLOCK, CAVITY AIR, BK HEATER, BIAS VOLTS, ION PUMP, IPA AIR, COLLECTOR COOLING, EXTERNAL INTERLOCK, FULL HEATERS, FOCUS CURRENT, HEATER DELAY, READY, BEAM VOLTS, IPA VOLTS, IPA POWER, OUTPUT POWER.

Fault status indicators are red LEDs and provide the monitoring of OUTPUT CAVITY ARC, SECONDARY CAVITY ARC, CABINET TEMPERATURE, MOTORS, HV STEP START, COLLECTOR CURRENT, COLLECTOR TEMP, ION CURRENT, BIAS CURRENT, CROWBAR FIRED, VSWR, BODY CURRENT, FOLDBACK ACTIVE, and LOCKOUT.

Remote control and monitoring facilities are provided for connection of remote control and telemetry or data logging equipment. When remote control is selected, commands given by continuous or momentary contact closures may be used to duplicate the functions of the local control buttons from a remote point.

Remote control and monitoring is via standard 37 pin "D" type connectors on each amplifier and the system control rack. Remote status indications for normal and fault conditions are made available at a TTL level. In addition, analog samples of voltage, current, and power levels are available as +4 Vdc into 100 k ohms at full scale deflection for connection to telemetry equipment.

Amplifier cabinet commands are selectable by jumper link for either open collector or TTL operation. TTL input voltage ranges are jumper selectable for +5 to +12 Vdc or +12 to +24 Vdc.

Internal meters (visible from the front of the transmitter) are display beam volts, beam current, grid volts, grid current, ion current, heater volts, and body current.

1.2.9 AGC and UHF Linearizer

Refer to Figure 1-4 AGC & UHF linearizer diagram.

An AGC and UHF linearizer is located in each amplifier cabinet and is in circuit between the exciter and IPA of each IOT. Its purpose is to cancel the intermodulation products generated by amplification in the class AB amplifiers, provide power amplifier AGC, power control, and VSWR foldback. The output power of the amplifiers are controlled and stabilized against variations in exciter output level, temperature, mains voltage, and gain variations of the IOT. In addition to AGC, there are four stages of correction. These consist of phase expansion, phase compression, gain expansion and gain compression. Each stage has a separate slope and threshold controls for either expansion or compression.

1.2.10 Intermediate Power Amplifier

The IPA uses a broadband solid state RF power amplifier module to amplify the on-channel 8VSB drive signal. Depending on the channel the transmitter is set up on, the system may be equipped with dual IPA modules.

The IPA operates in class AB amplification. The drive signal is split to feed two identical halves of the IPA, which operate in parallel. Each half has a gain of approximately 45 dB. Each half

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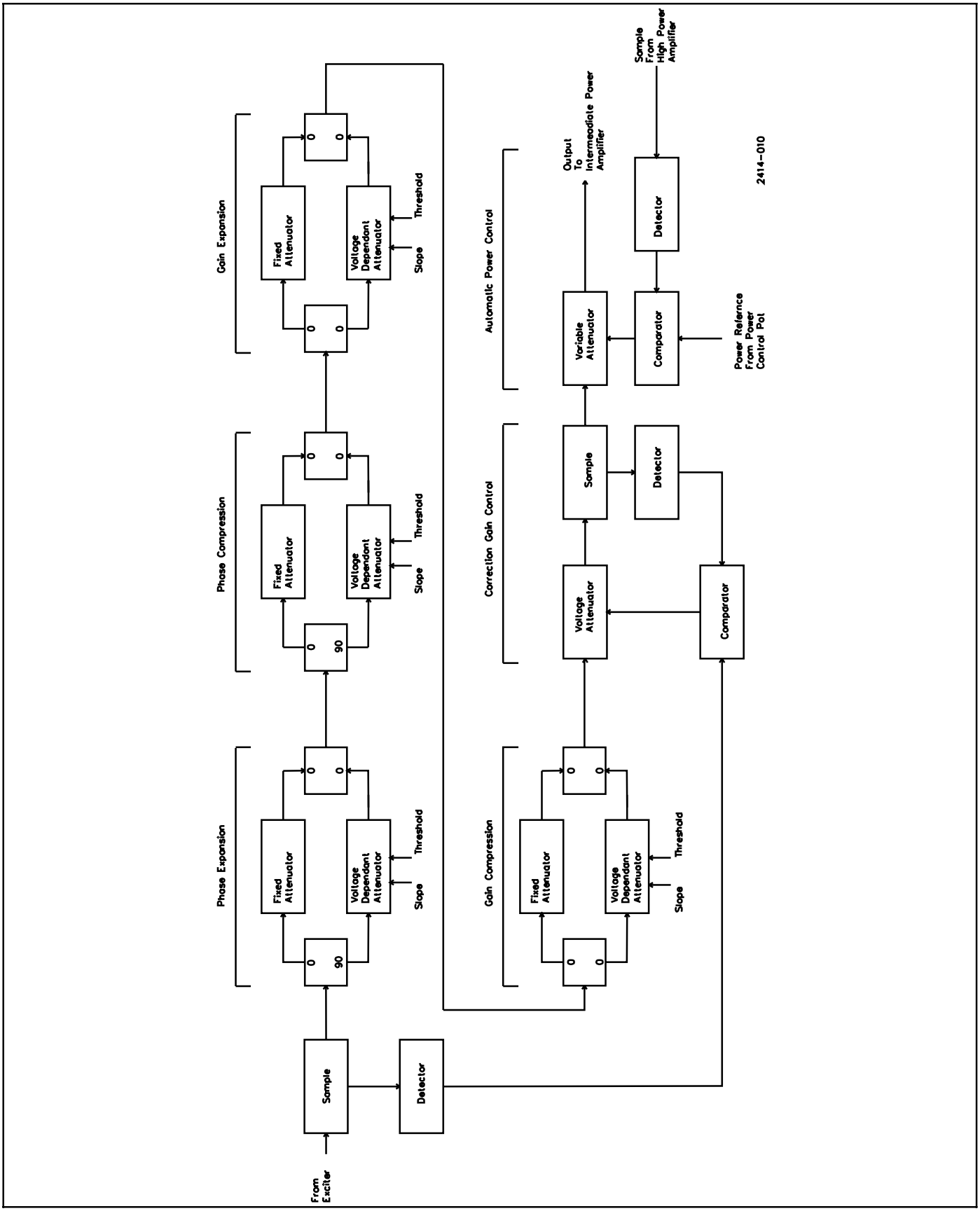

Figure 1-4. AGC & UHF Linearizer Block Diagram

WARNING: Disconnect primary power prior to servicing.

of the IPA module consists of a gain stabilizer, three class A stages in cascade, a class AB driver stage and four class AB output stages operating in parallel.

The gain stabilizer holds the gain of the class A and driver stages constant against changes caused by operating frequency drift and temperature changes. The collector current of the driver stage is sampled and a voltage is derived which varies the bias current of the class A/B driver stage. In like manner, the bias current of the class A/B output stages is controlled by the average collector current of all of the output stages.

The driver and output stages use a Motorola bipolar transistor which is capable of 125 W peak (31 W average DTV power) per device. Each class AB stage is provided with crowbar protection. The output of each pair of output transistors is combined to give four co-phased outputs from the module. These pass via circulators, which provide a constant load to the transistors, to a broadband four way star point combiner. If dual IPA modules are used, the four outputs from each module pass via circulators to an eight way star point combiner.

Depending on its requirements, the IOT input drive ranges from 200 to 1000W peak (50 to 250 W average power for DTV). Each IPA module is capable of 1000 W peak (250 W average for DTV) which, due to feed forward system loss, translates to 560 W peak (140 W average for DTV) at the input of the IOT. A second IPA is added when more than 140 W average drive power is needed at the IOT input.

The IPA is self protecting. A fast acting attenuator removes the drive to each half independently if collector current, reflected power or temperature become excessive. The output power is monitored on a front panel meter and serial status and measurement data are available for diagnostic purposes. A single IPA module is supplied by two paralleled, high efficiency, single phase, fan cooled switched mode supplies. Dual IPA modules are supplied by three such paralleled supplies. One IPA supply is capable of powering an IPA module to full output power.

1.2.11 Feed Forward Assembly

The feed forward assembly consists of a class-A 1-watt reference amplifier, line stretchers for phasing, a fixed delay line, two combining hybrids, and a 40 watt error correction amplifier. The purpose is to improve the linearity of the IPA output signal.

The input signal to the IPA module(s) is reasonably clean, but the IPA adds intermodulation products (intermods) to its output signal. A sample of the IPA input signal is amplified in the 1-watt amplifier and added to a sample of the IPA output signal in a combining hybrid. The phase of the two signals is such that the input signal is canceled leaving only the intermods. The intermod signal is amplified in the 40 watt amplifier and added into the IPA output signal (at a point after the first IPA sample was taken) in a combining hybrid. The phase of the two signals is such that the intermods cancel out leaving a reasonably clean IPA signal to drive the IOT amplifier.

1.2.12 EEV IOT Assembly

For operation as a UHF DTV power amplifier, the IOT is mounted in an assembly which contains the tuned input and output RF circuits together with magnet coils which focus the electron beam within the drift tube section of the IOT. The complete assembly of IOT, RF circuitry and magnetic coils are mounted together on a wheeled framework to form a unit (the IOT trolley assembly) which may be easily removed from the transmitter for maintenance purposes. The points of interconnection which interface the IOT trolley assembly to the transmitter are:

- Self sealing, quick release coolant connectors
- Air cooling pipe
- RF input cable
- Output RF transmission line
- Forward power probe
- Reflected power probe
- ALC probe
- Umbilical feed for HV cables
- Magnetic supply cable
- Collector return and interlocks connector
- Earth wire connection

The input circuit is in the form of a co-axial transmission line with an annular tuning door. It uses two cavity models (3/4 wavelength at the low frequency end and 5/8 wavelength at high frequency end) to allow coverage of the uhf band. A coupling loop connects the RF input signal to the transmission line input cavity. The IOT input circuit is adjusted to 50 ohms by an externally mounted double slug matching section.

The IOT requires beam supply voltage that ranges from 32 to 36 kV. The grid cathode assembly of the IOT is maintained at the negative beam supply potential while the IOT collector and the positive terminal of the beam supply are maintained within a few volts of ground potential. Beam supply tap settings are available to vary the beam voltage in order to operate 40, 50, 70 or 100 kW peak tubes. (EEV IOTD140W/R, IOTD150W/R, IOTD250, IOTD270, IOTD2100).

The heater, grid, and Ion power supplies all float at the cathode (negative beam) potential. The heater transformer isolates the cathode voltage from earth. Grid and Ion supplies are fed from a common high voltage isolation transformer and are contained in the isolated supplies assembly, which floats above ground on standoff insulators.

Wires providing the dc supplies to the cathode/grid section of the IOT are connected at a junction box located at the top of the input cavity assembly. RF drive is capacitively coupled to the high voltage cathode structure.

Two tuned cavities are coupled together to produce a bandpass filter circuit which is used to transfer the RF power from the IOT output to the output transmission line. Coupling from the primary to secondary cavity is by means of an adjustable coupling loop and capacitive probe. The output coupler is a standard variable loop coupler.

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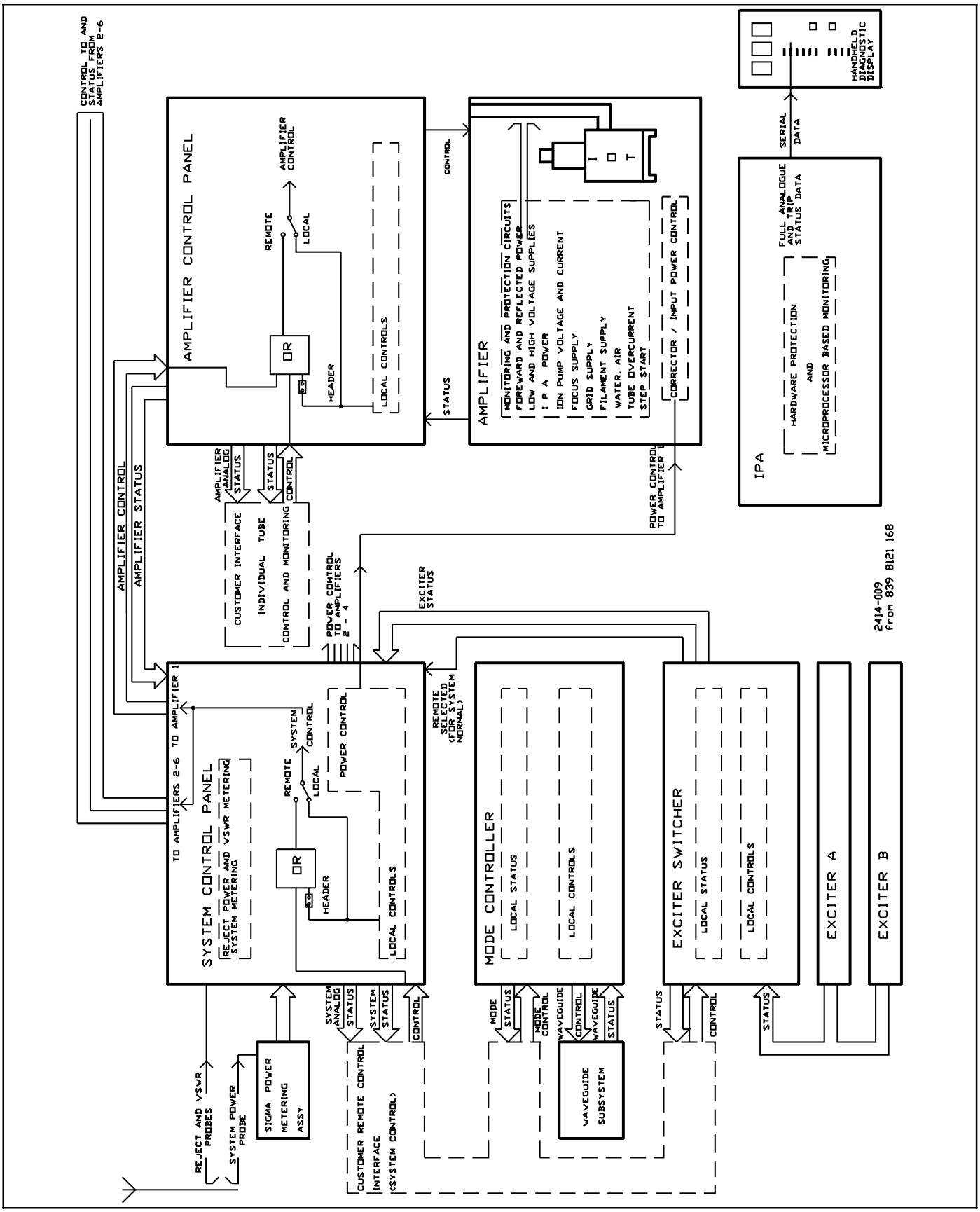

Figure 1-5. IOT Control System Overview

WARNING: Disconnect primary power prior to servicing.

1.2.13 CPI Klystrode Assembly

For operation as a UHF DTV power amplifier, the CPI Klystrode is mounted in an assembly which contains the tuned input and output RF circuits together with magnet coils which focus the electron beam within the drift tube section of the Klystrode. The complete assembly of Klystrode, RF circuitry and magnetic coils are mounted together on a wheeled framework to form a unit (the trolley assembly) which may be easily removed from the transmitter for maintenance purposes. Tube removal may be accomplished with the trolley assembly in position within the amplifier cabinet.

The points of interconnection which interface the trolley assembly to the transmitter are:

- Self sealing, quick release coolant connectors
- Air cooling pipe
- RF input cable
- Output RF transmission line
- Forward power probe
- ALC probe
- Reflected power probe
- Umbilical feed for HV cables
- Magnetics supply cable
- Collector return and interlocks connector
- Earth wire connection

The input circuit is in the form of an RF cavity driven grid. Input tune and match controls provide correct input adjustment over the UHF band.

The CPI Klystrode requires beam supply voltage that ranges from 32 to 36 kV. The grid cathode assembly of the Klystrode is maintained at the negative beam supply potential while the Klystrode collector and the positive terminal of the beam supply are maintained within a few volts of ground potential. Beam supply tap settings are available to vary the beam voltage in order to operate the 40, 60, 75, and 100 kW Peak Klystrodes (CPI K2D40W, K2D60W, K2D75W and K2D110W.)

The heater, grid, and ion power supplies all float at the cathode (negative beam) potential. The heater transformer isolates the cathode voltage from earth. Grid and ion supplies are fed from a common high voltage isolation transformer and are contained in the isolated supplies assembly which floats above ground on ceramic standoff insulators.

Wires providing the dc supplies to the cathode/grid section of the Klystrode are connected to a filter network within the input cavity assembly. RF drive is capacitively coupled to the high voltage cathode structure.

Two tuned cavities are coupled together to produce a bandpass filter circuit which is used to transfer the RF power from the Klystrode output to the output transmission line. Coupling from the primary to secondary cavity is by means of an adjustable coupling iris. The final output coupler utilizes a capacitive probe to couple the output to EIA 3 1/8 inch transmission line.

1.2.14 IOT Crowbar Assembly

WARNING

THE IOT CROWBAR ASSEMBLY RESIDES AT A HIGH VOLTAGE POTENTIAL IN THE ORDER OF -35 kV WITH RESPECT TO EARTH. MAINTENANCE OF ANY DESCRIPTION SHOULD ONLY BE CARRIED OUT WHEN THE TRANSMITTER HAS BEEN ISOLATED FROM THE SUPPLY AND EARTHED.

1.2.14.1 General Description

The IOT crowbar is a high voltage shunt switch. Its purpose is to protect the IOT from damage in fault conditions, i.e. internal tube arcs. Under such conditions, an unprotected tube will draw excessive current from the HV power supply. This excessive current, aided by the energy stored in the decoupling capacitors, causes damage to the tube.

During a tube arc or HV cable fault, the crowbar detects the sudden rise in beam supply current. This causes the crowbar circuit to trigger, which places a short circuit across the beam supply. The main component of the crowbar is a deuterium thyratron. It is connected across the beam supply output, anode to the positive terminal and cathode to the negative terminal. When triggered, the thyratron conducts heavily, diverting the follow of beam supply energy away from the IOT, there by preventing further damage.

When triggered, the crowbar informs the amplifier controller that a fault has occurred. The amplifier control logic immediately turns the line control cabinet HV breaker off and lights the fault status indicator. After a short delay, the amplifier control logic generates a breaker reset command to turn on the HV breaker.

1.2.14.2 Construction

The crowbar assembly consists of an electrically floating chassis, which is at the full beam voltage under normal operating conditions. It is isolated from earth potential by four nonconductive pillars. ac operating power for the crowbar power supply and thyratron filament voltage is supplied by an isolating transformer.

The floating chassis provides a means of mounting the thyratron device and its associated control circuitry, which consists of the floating deck unit, the FDU/thyratron interface PCB and power supply. A dc fan is used to provide sufficient airflow onto the base of the thyratron to prevent overheating and pre-triggering.

Fuses for the secondary of the FDU transformer are located on a horizontal flange of the chassis.

Two more insulating pillars are fixed to the floating chassis, one to provide support to the IOT supply series resistors, the other providing support for the grading grid divider and crowbar fired detector.

1.3 Size and Weight

Refer to Table 1-1.

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1.4 Heat Load Requirements

Refer to Table 1-2.

Heat loss from the liquid coolant plumbing into the room is significant but can be reduced to virtually zero by using a good quality foam pipe insulation (preferably with a protective plastic outer covering). Please note that these figures are approximate. Good engineering practice would dictate the allowance of an additional 10-15 % head room when using these figures to accurately size air conditioning units (plus the heat load of all other building loads). Refer to Table 1-2.

Pipe lengths were assumed to be a total of 100 foot inside the building. If pipe lengths are different please allow 2.4 kW per 100 foot for 1-1/2 inch pipe, 3.3 kW per 100 foot for 2 inch pipe, and 4.13 kW per 100 foot of 2.5 inch pipe.

For full information on the size/weight/power consumption/performance specifications consult the data sheets included in the front of this manual.

Table 1-1. Weights and Measurements

ITEM	Net Weight		Size (width x depth x height)	
	kg	lb	cm	in
Control Cabinet	164	362.44	106 x 84 x 183	23.5 x 33.1 x 72
Rear P.A. Cabinet	282	623.22	149 x 56 x 183	58.5 x 22.2 x 72
Front P.A. Cabinet	334	738.14	149 x 84 x 183	58.5 x 32.2 x 72
Line Control Cabinet	136	300.56	153 x 31 x 92	60 x 12.1 x 36.1
Beam Supply, 96 KW	1678	3700	141 x 117 x 157	55.5 x 46 x 62
Beam Supply:, 140 kW	1995	4400	152 x 117 x 157	60 x 46 x 62
Pump Module	362	800	91 x 157 x 158	36 x 61.6 x 65.25
Fluid Cooler (two fans)	311	685	232 x 111 x 110	91.5 x 43.6 x 43.2
Fluid Cooler (three fans)	429	946	334 x 111 x 110	131.5 x 43.6 x 43.2
Fluid Cooler (four fans)	608	1340	436 x 111 x 110	171.5 x 43.6 x 43.2
Dependent upon type system installed, RF Systems: (RF Systems will typically ship directly from manufacturer.)				
Allow for a slight increase of the above sizes for the shipping containers. The skid will add at least 6 inches (15 cm) to the height.				

Table 1-2. Transmitter Heat Loads For Air Conditioner

Transmitter Size	Pipes Uninsulated kW BTU/Hr	Pipes with Insulation kW BTU/Hr
1-Tube	8 27,300	5.6 19,100
2-Tube	13 44,400	9.7 33,100
3-Tube	18 61,400	13.9 47,400
4-Tube	25 85,300	18.4 62,800

WARNING: Disconnect primary power prior to servicing.

2.1 General

This section provides the information and instructions necessary for the installation of the Harris **Sigma® CD series television transmitter. Guidelines in the form of installation instructions are given to minimize the installation time required. Care and precautionary measures are given to prevent problems or injury from occurring during installation.**

Probably the most important factors in a successful, efficient, and safe installation phase of a new transmitter are planning and preparation. Study equipment manuals beforehand and become thoroughly familiar with the installation requirements for each piece of equipment.

When considering the sequence of events during an installation, it is important to approach the transmitter, its peripherals, and the building as a system. "Typical" drawings will be used as references. It must be assumed special requirements will cause deviations from the published installation drawings in order to accommodate a particular configuration or building requirement.

Plan the DTV monitoring systems ahead of time and draw schematics and/or wiring diagrams for them. If possible, install them. Plan and, if possible, install the microwave system (if used). Plan the remote control system, if the plant will be so equipped. Know where the remote equipment will mount and what parameters it should monitor and what functions it should control.

The transmitter equipment installation phases should be planned before the equipment arrives and a detailed plan worked out and written down. Know what installation equipment and materials HARRIS is supplying with the transmitter and what equipment and materials the station must supply. In general, a transmitter installation requires that the following areas be addressed:

a. In a new installation, will the building/transmitter room be completed? Transmitting equipment and any electronic equipment can be damaged or made inoperable by dust and dirt entering the equipment. Even a plastic covering placed over the transmitter rarely keeps out concrete dust and plaster dust created from drywall installation. Interior walls should be in place, ceiling work should be complete, concrete floors should be aged and well sealed.

b. In a new installation, will electrical power be available when needed? Often transmitter installation and checkout is held up because primary power is not available for the transmitter.

c. In an existing facility, must an existing transmitter remain on the air during installation of the new equipment? Plan how this is to be done to minimize off-air time.

d. A staging area should be chosen and set aside to place the boxes and crates that contain all the smaller parts and assemblies not shipped attached to the transmitter. A separate area should be used to stage all installation materials (plumbing materials, wire, conduit and accessories, loose hardware, etc.). Each piece of equipment should be inspected for shipping damage. Inventory all equipment and the contents of each box and compare to the packing check list that comes with the equipment.

e. Unloading. Will the proper lifting and moving equipment be there when the truck containing the transmitter arrives? Will there be enough workers there to help?

f. Equipment placement. Using a station layout drawing, determine equipment placement and in what order equipment should be set in place. If possible, lay out equipment location with lines marked on the floor.

g. Hanging hardware. Ensure that all pipe hangers, conduit hangers, threaded rod, beam clamps, Unistrut and Unistrut hardware are on site.

h. Tools. Ensure that all necessary tools will be on site when needed. Make sure all tools are in good shape. Check transmitter and other equipment technical manuals to see if any specialized tools are required. Make arrangements to obtain them if necessary. A list of installation tools and materials is shown in Table 2-1

2.2 Delivery And Storage

The **Sigma® CD** series transmitter is normally delivered with the larger units mounted on shipping skids. Smaller components are shipped in cardboard cartons. Any obvious damage should be noted at the time of receipt and claims filed with the carrier.

In unloading the equipment, the receiver will need suitable equipment capable of handling a 5000 pound load (2268 kg). Extreme care should be taken during the unloading operation to prevent injury to personnel or damage to the equipment.

If storage of the equipment is necessary, all units except the oil filled high voltage power supply and cooling unit require inside storage. Except for the small cardboard cartons, stacking of items should not be done. The storage area should be dry and clean.

Leave the larger units mounted on their skids for ease of storage and movement. When it is time to install the equipment, move it close to its final position and there remove it from its skid and slide it into position.

2.3 Returns And Exchanges

Information on returns and exchanges is printed on the reverse side of the title page of this manual.

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Table 2-1. Installation Tools and Materials

Welding Torch Set
Oxygen and Acetylene Tanks
Welder's Mask or Goggles
Power Band Saw (can be rented) and Extra Blades
Silver Solder 1/16 inch diameter, 30%-45%, Hard Stay-Silv #45, Aladdin #45, HARRIS part number 086-0004-060
Paste flux (Engelhard Ultra-Flux 1 lb jar) HARRIS part number 099 0002 241
(HARRIS part number 086 0004 040, 16 oz bottle)
Muriatic Acid (quart)
Baking Soda (two 1-pound boxes)
Three plastic 5-gallon buckets or containers with open tops
Scotch Brite
Steel Wool
Emery Cloth (roll type like plumber uses)
Carpenters Square
Level
Plumb Bob
Chalk Line
Hacksaw and Extra Blades
Wrenches
Crowbar
Rope
Saw Horses or Cutting Table
Come-along or Chain-Fall Hoist
Ladders
Files
Garden Hose
25-Ft Tape Measure
Hole Saw, 1-7/8 inches, for installing directional couplers
Rubber Hammer
Claw Hammer
Gloves
Safety Glasses
NOTE: All-thread rod, hangers, angle iron or channel will be needed to support the transmission line, dummy load, etc.

2.4 Unpacking

The following guidelines are provided for ease of unpacking the equipment.

2.4.1 Equipment Inventory

Inventory shipment using the packing check list received from the carrier. A typical list of units shipped is shown in Table 2-2.

See Section VII for a list of the installation material normally supplied with the transmitter.

2.4.2 High Voltage Power Supplies

Each high voltage power supply weighs approximately 5000 pounds, necessitating the use of suitable lifting equipment.

When handling the power supply, keep the plastic envelope in place for protection in storage unless the equipment can be installed soon after its arrival.

To remove from the truck, a forklift can be used (winching the equipment to the rear edge if a loading platform is not available), or the equipment can be lifted using the lugs provided on the sides. When inserting the lifting hooks into the lugs, keep any tearing of the plastic envelope to a minimum. If there are high voltage bushings, take care not to bear any force on them. Use spreaders on the slings, if necessary. Provide padding as necessary to protect the painted surfaces from the sling.

2.4.3 Dry High Voltage Power Supply

An optional dry high voltage power supply is available. See customer special documentation for installation, checkout, and other information.

2.5 Equipment Placement

2.5.1 Typical Station Layouts

The recommended equipment placement depends somewhat on the operating channel, especially if operation is to be at channel 52 or higher. Refer to the typical station layout and plumbing drawings. These drawings provide useful information regarding floor plan, RF transmission line layout, and the cooling system.

See site specific transmitter installation drawings.

2.5.2 Beam Supplies, Pump Module And Heat Exchanger Fan Units

It is recommended that the beam power supplies, pump module, and heat exchanger fan unit be mounted on a concrete pad in a secure area outside the building. Provisions for ice bridge protection should be made if required due to geographic location.

When ready for installation, use a fork lift or other suitable equipment to carefully remove the pump module and fan unit from their skids and set them in place on their pads.

The beam supply must be lifted off of its skid using the lugs provided on the sides. Provide padding as necessary to protect the painted surfaces from the sling.

2.5.3 Line Control Cabinets

Place the line control cabinet according to the floor plan.

2.5.4 RF System

Study the typical station layout drawings or custom layout drawings before beginning installation of the RF system. The RF system is the assembly that connects the RF output lines from one or more PA cabinets to the input of the antenna feed line.

For a single tube configuration, the RF system consists of a filter and possibly a patch panel or motorized RF switch.

For a multiple tube configuration, the RF system includes one or more combiners, one or more filters, and possibly one or more motorized RF switches. These larger RF systems may be shipped

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Table 2-2. Weights and Measurements

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	kg	lb	cm	in
Control Cubicle	164	362.44	106 x 84 x 183	23.5 x 33.1 x 72
Rear PA Cubicle	282	623.22	149 x 56 x 183	58.5 x 22.2 x 72
Front PA Cubicle	334	738.14	149 x 84 x 183	58.5 x 32.2 x 72
Line Control Cabinet	136	300.56	153 x 31 x 92	60 x 12.1 x 36.1
Beam Supply, 96 KW	1678	3700	141 x 117 x 157	55.5 x 46 x 62
Beam Supply:, 140 kW	1995	4400	152 x 117 x 157	60 x 46 x62
Pump Module	362	800	91 x 157 x 158	36 x 61.6 x 65.25
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Fluid Cooler (four fans)	608	1340	436 x 111 x 110	171.5 x 43.6 x 43.2
Dependent upon type system installed, RF Systems will typically ship directly from the manufacturer.				

disassembled in two or more sections, which must be reassembled on site.

The horizontal and vertical placement of the RF system in relation to the transmitter is crucial to the successful installation of the interconnecting lines and the antenna transmission line. Refer to Figures 2-1 and 2-2 for relative phasing information for the multi-tube configurations. Phasing is accomplished by controlling the relative height or length of the RF lines that connect the PA cabinets to the RF system.

2.5.4.1 RF System Mounting Height

The mounting height of the RF system is determined by many factors, which include:

- The height of the ceiling
- Available floor area inside the transmitter room
- Whether the input and output RF lines enter from above or below the RF system, they can be setup either way at the site
- The length of the phasing lines
- If a patch panel is to be used,

Depending on the required phasing length of the PA to RF system lines (for multiple PA systems) and the mounting height of the RF system, the PA inputs can be arranged (on site) to enter the RF system from above or below. Also, the RF system antenna output can go above or below, depending on the RF system height and the height of the transmission line or wave guide run to the antenna.

2.5.4.2 Optional Patch Panel

If a patch panel (optional) is to be installed, for most RF system designs, the minimum mounting height of the bandpass filter is dictated by the mounting height of a horizontally mounted patch panel. The patch panel should be installed so it can be operated from the floor, yet it should not be low enough to cause a hazard in a high traffic area. If the quantity of coaxial elbows needed to connect the panel to the bandpass filter is to be minimized, the bandpass filter must be elevated above the patch panel by the exact distance equivalent of two leg lengths of a 4-1/16" or 6-1/8" elbow. If the bandpass filter is to be mounted higher, then it must be at least 6" higher than two elbow leg lengths to accommodate the shortest length of 4-1/16" or 6-1/8" transmission line possible. See Appendix A to determine elbow leg lengths.

Finally check to make sure that the patch panel mounting location will not interfere with the clearance needed to open the IOT cabinets rear doors.

2.5.4.3 RF System Placement

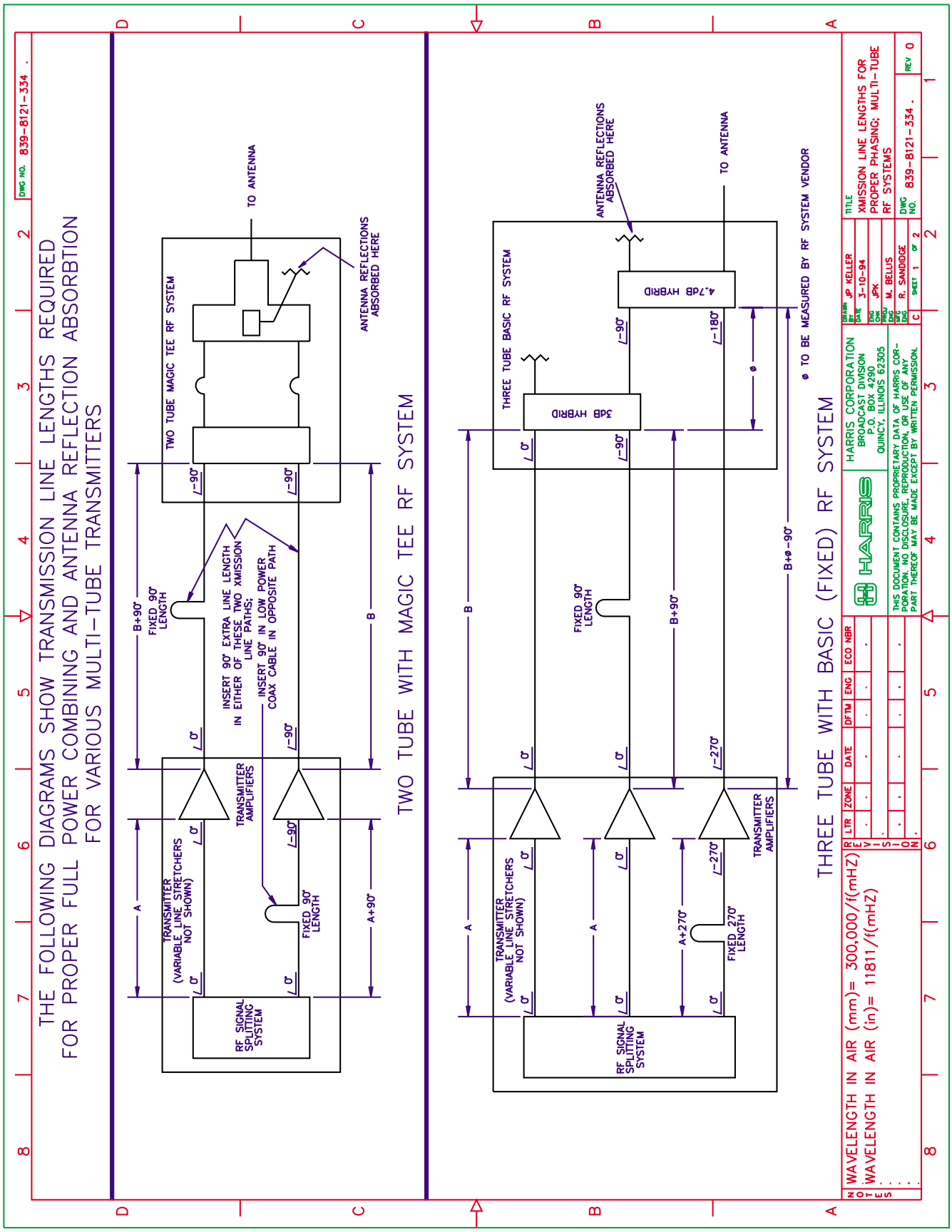
For system specific data refer to the vendor supplied RF system manual.

Identify the RF system input ports on the layout drawing and determine its location with respect to the transmitter. Locate the same point on the floor of the room and mark it.

Support the center sections of the filter above the floor and orient the section so the inputs of the Rf system, when attached, will be close to being directly over the previously made marks on the floor. The filter can be supported by setting it on the interconnecting flanges. Do not support the assembly on the wave guide sections of the filter or on the protruding filter tuners. Use care not to bump the tuners or dent or deform the wave guides or filter sections.

If used, install the magic tee phase shifter assembly to the filter section using marking or labeling on the pieces as a guide. Support the magic tee section carefully to avoid denting or deforming it, and to assist in aligning the connecting flanges.

WARNING: Disconnect primary power prior to servicing.


THE FOLLOWING DIAGRAMS SHOW TRANSMISSION LINE LENGTHS REQUIRED FOR PROPER FULL POWER COMBINING AND ANTENNA REFLECTION ABSORBTION FOR VARIOUS MULTI-TUBE TRANSMITTERS
DWG NO. 839-8121-334 .
TWO TUBE WITH MAGIC TEE RF SYSTEM
TWO TUBE MAGIC TEE RF SYSTEM
TO ANTENNA
ANTENNA REFLECTIONS ABSORBED HERE
INSERT 90° EXTRA LINE LENGTH IN EITHER OF THESE TWO XMISSION LINE PATHS; INSERT 90° IN LOW POWER COAX CABLE IN OPPOSITE PATH
FIXED 90° LENGTH
TRANSMITTER AMPLIFIERS
TRANSMITTER (VARIABLE LINE STRETCHERS NOT SHOWN)
RF SIGNAL SPLITTING SYSTEM
B+90°
B
A
A+90°
0°
-90°
THREE TUBE WITH BASIC (FIXED) RF SYSTEM
THREE TUBE BASIC RF SYSTEM
3dB HYBRID
4.7dB HYBRID
ANTENNA REFLECTIONS ABSORBED HERE
TO ANTENNA
FIXED 90° LENGTH
FIXED 270° LENGTH
TRANSMITTER AMPLIFIERS
TRANSMITTER (VARIABLE LINE STRETCHERS NOT SHOWN)
RF SIGNAL SPLITTING SYSTEM
B+90°
B+ø-90°
ø TO BE MEASURED BY RF SYSTEM VENDOR
A+270°
-90°
-180°
-270°
NOTES:
1. WAVELENGTH IN AIR (mm)= 300,000/f(mHZ)
2. WAVELENGTH IN AIR (in)= 11811/f(mHZ)
REVISIONS
LTR ZONE DATE DFTM ENG ECO NBR
HARRIS
HARRIS CORPORATION
BROADCAST DIVISION
P.O. BOX 4290
QUINCY, ILLINOIS 62305
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DRAWN BY JP KELLER
DATE 3-10-94
CHKD JPK
PROJ
DWG M. BELUS
ENG R. SANDIDGE
SHEET 1 OF 2
TITLE
XMISSION LINE LENGTHS FOR PROPER PHASING; MULTI-TUBE RF SYSTEMS
DWG NO. 839-8121-334 .
REV C
REV 0

Figure 2-1. Line Lengths for Phasing - Multi-Tube

WARNING: Disconnect primary power prior to servicing.

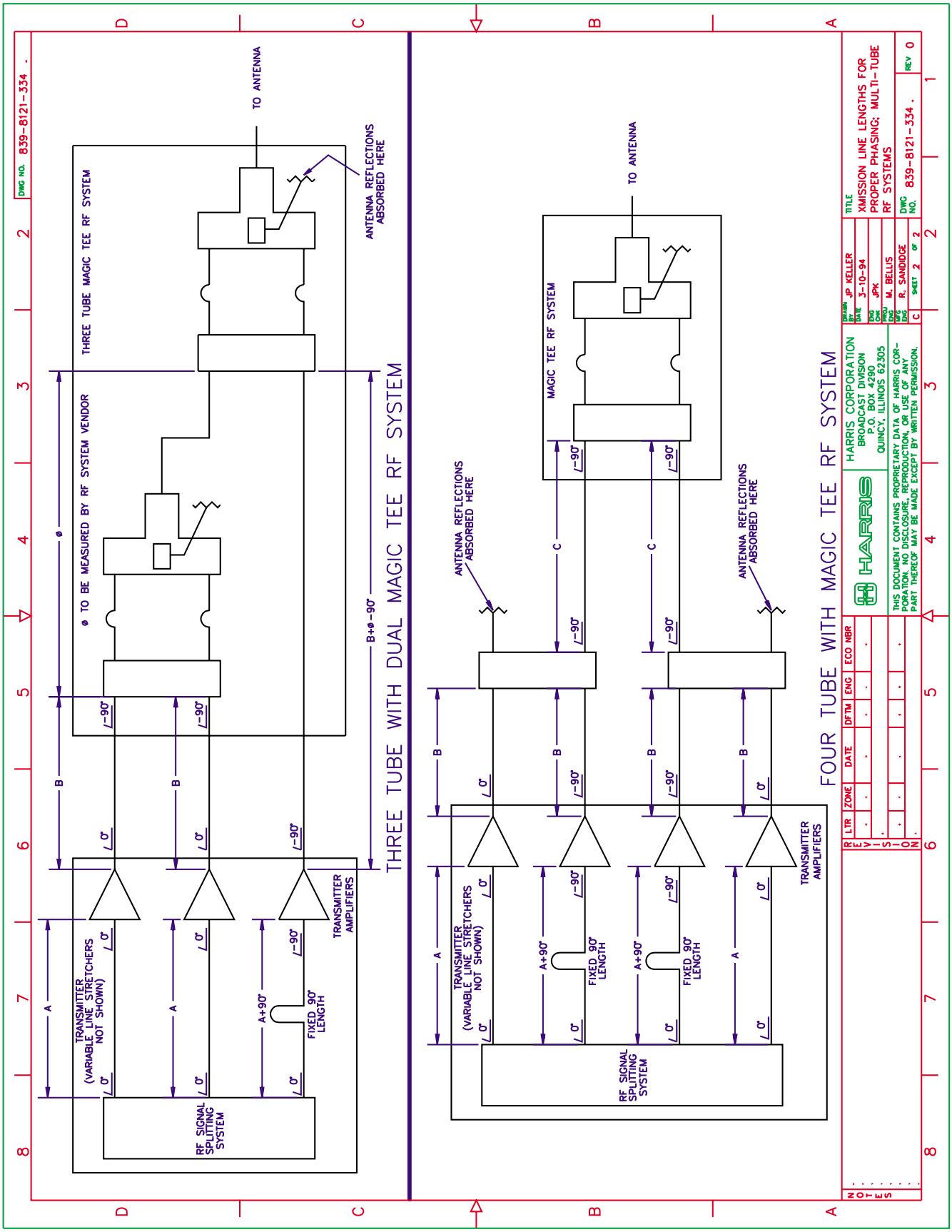
THREE TUBE WITH DUAL MAGIC TEE RF SYSTEM
FOUR TUBE WITH MAGIC TEE RF SYSTEM
THREE TUBE MAGIC TEE RF SYSTEM
Ø TO BE MEASURED BY RF SYSTEM VENDOR
TO ANTENNA
ANTENNA REFLECTIONS ABSORBED HERE
MAGIC TEE RF SYSTEM
TRANSMITTER (VARIABLE LINE STRETCHERS NOT SHOWN)
TRANSMITTER AMPLIFIERS
FIXED 90° LENGTH
RF SIGNAL SPLITTING SYSTEM
HARRIS CORPORATION
BROADCAST DIVISION
P.O. BOX 4290
QUINCY, ILLINOIS 62305
TITLE
XMISSION LINE LENGTHS FOR PROPER PHASING; MULTI-TUBE RF SYSTEMS
DWG NO. 839-8121-334 .
REV 0
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Figure 2-2. Line Lengths for Phasing - Multi-Tube

WARNING: Disconnect primary power prior to servicing.

Alignment pins are provided and should be used in diagonal corners to assure proper seating of flanges. The flange bolts should be used to hold the two flanges together and not to correct flange misalignments. Tighten the bolts in the sequence shown in Figure 2-3; then torque each to 15 ft. lbs.

Position the input ports of the assembled combiner/filter directly over the mark on floor using a plumb bob. Also using the plumb bob, locate the proper placement and install the all-thread rods from the overhead support system. Locate the rods so they are directly over the hanging brackets on the RF system. Raise the RF system using suitable hoists and pulleys. Level the RF system when its proper height is reached and it has been attached to the all-thread rods.

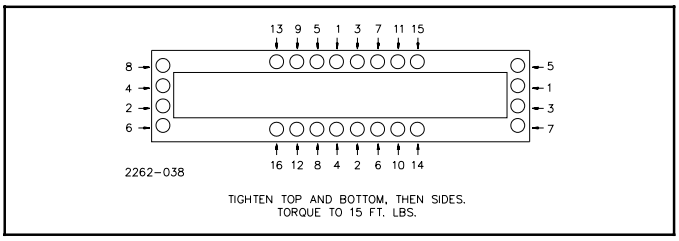

Figure 2-3. Tightening Sequence

If the RF system arrived in two or more sections,and each section is very heavy, or the entire system to bulky or heavy to hang as a unit, the system can be hung one section at a time and the sections joined after they are hung.

NOTE

The length of the threaded rods hanging the RF system should be as short as possible to minimize objectionable lateral movement. If the RF system equipment is to be supported from a high ceiling, an intermediate metal frame grid should be constructed. The frame normally hangs from the ceiling and in turn provides the structure from which the RF system is suspended.

2.5.5 Optional Automatic Voltage Regulator (AVR)

Place the AVR according to the floor plan.

CAUTION

THE AVR MUST BE CAPABLE OF MAINTAINING +/-2% OUTPUT REGULATION AT THE SPECIFIED LINE VOLTAGE. FAILURE TO MAINTAIN THIS SPECIFICATION MAY RESULT IN SPURIOUS CROWBAR EVENTS AND POSSIBLE VOIDING OF IOT WARRANTY.

2.5.6 Transmitter Cabinets

Carefully remove cabinets from skids.

CAUTION

UNIT MUST NOT BE DROPPED. MAKE A RAMP TO ROLL UNIT FROM SKID TO FLOOR.

Doors, if not already mounted on cabinets, are wrapped in protective material. Do not use a knife or other sharp object to remove wrapping, as these tools may damage the finish.

Cardboard cartons should be opened with the carton in the proper position (note "UP" arrows on carton). Parts contained inside the cartons are wrapped. Use extreme care when unwrapping parts to avoid dropping or discarding parts as waste.

2.5.6.1 Placing and Joining Transmitter Cabinets

Refer to the typical station layout and proceed as follows:

a. The RF system should already be hung according to the layout plan.
b. In the event the RF system arrives much later then the transmitter and the installation must proceed, allow space to lift and hang the RF system and run the RF lines.
c. Snap a chalk line on the floor where the front of the transmitter cabinets will rest. Also snap a chalk line on the floor where one end of the transmitter cabinets will rest.
d. Begin moving the control cabinet and the front half of each amplifier cabinet into place lining it up with the chalk lines. It is a good idea to level each cabinet as it is moved into its final position.

The front and rear halves of the amplifier cabinet were split prior to shipment and must be reassembled. The following procedure is a guideline to rejoining the two halves of the cabinet.

1. Move the rear cabinet close to its permanent place but leave the two halves of the cabinet separated by about two feet.
2. Remove the two cross braces from the rear of the front half of the cabinet. Save the mounting bolts and washers, they will be used to fasten the rear half of the cabinet to the front.
3. Reinstall the bias pot assembly to the rear side of the front cabinet meter board.
4. The front wall of the rear half of the cabinet will become the rear wall of the front when the two halves are joined.
5. Remove shipping support blocking for the isolated supply board, and any other packing material and blocks from the amplifier cabinet.
6. Route the (IOT top hat assembly) umbilical through the front wall of the rear cabinet (high voltage cubical). Facing the front of the front half of the amplifier cubical, the umbilical will hang in the left rear corner of the IOT trolley area. The umbilical (with IOT top hat attached is wrapped and stored in the rear cabinet for shipping.
7. Slide the rear half of the PA cabinet up to the front half until they are together.
   As the rear half approached the front half, make sure that the copper ground strap coming out of the center bottom rear of the front cabinet slides through the matching slot in the center bottom of the front wall of the rear cabinet. This strap will bolt to the other copper ground straps that are inside the rear cabinet.
8. Mechanical assembly. Bolt front and rear IOT cabinets together with four 3/8 X 1 inch bolts. Mounting holes are located in the upper and lower corners of the rear IOT cabinets. Ensure cabinets are level and square.

WARNING: Disconnect primary power prior to servicing.

9. Connect internal cabinet ground strap from front IOT cabinet to the ground straps in the rear IOT cabinet.
10. Connect all ground jumper wires in the cabinet corners. These wires were disconnected when the front and rear halves of the amplifier cabinet were separated.
11. Bolt the amplifier cabinets together (if more then one), and the exciter/control cabinet to amplifier cabinet. Use the provided aluminum bolt plates to bolt the amplifier cabinets together at the top corners of the cabinets.
12. Locate the copper ground strap provided with the electrical installation kit. Determine the optimum layout for routing the ground strap to allow connection of the transmitter components with as few bends as possible.
13. Connect station ground between all transmitter cabinets, beam supplies, pump modules, heat exchangers, line control cabinets and the RF system.
14. Connect ground sticks in the IOT front cubicle and on the back of the amplifier high voltage cabinets. Using an ohmmeter check for electrical continuity to station ground.

WARNING

ENSURE GROUND STRAPS ARE CONNECTED BETWEEN CABINETS, HIGH VOLTAGE POWER SUPPLIES, LINE CONTROL CABINETS, AND OTHER TRANSMITTING EQUIPMENT. BOND THE STRAPS TO STATION GROUND AT A CENTRAL POINT. AT A MINIMUM THE STRAPS SHOULD BE BOLTED TOGETHER USING SEVERAL BOLTS AND LARGE WASHERS AT EACH CONNECTION TO MAXIMIZE THE COMPRESSED SURFACE AREA OF THE STRAPS. IT IS RECOMMENDED THAT THE CONNECTIONS ALSO BE SILVER SOLDERED OR CADWELDED. FOR INFORMATION ON LIGHTNING PROTECTION AND SYSTEM GROUNDING REFER TO APPENDIX B & C.

2.5.7 EEV IOT Uncrating and Assembly

A chain hoist assembly is supplied to facilitate the installation of the IOT into the magnet/carriage assembly. Refer to the station layout drawings for proper hoist installation height.

CAUTION

THE IOT WEIGHS APPROXIMATELY 22 kg/50 lbs BY ITSELF; 86 kg/190 lbs WHEN THE WEIGHT OF THE SHIPPING FRAME IS INCLUDED. THE IOT LIFTING SUPPORT STRUCTURE MUST BE CAPABLE OF SUPPORTING THIS LOAD. THE CHAIN HOIST SUPPORTING STRUCTURE MUST BE STRONG ENOUGH TO SUPPORT A LOAD AT LEAST EQUAL TO RATING OF THE HOIST (1 TON).

If the IOT has been sitting in its crate for an extended period of time, it may be desirable to check the quality of the vacuum inside the IOT while it is still in the crate. This is done by applying voltage between the IOT's vac-ion pump and heater/cathode terminal and measuring the current being drawn by the pump. The exact procedure for the ion pump test is provided by the tube manufacturer in the IOT amplifier assembly manual.

Closely follow the IOT manufacture's instructions provided with the tube to unload the IOT from the shipping crate.

Ensure that the IOT is correctly located in the magnet structure and that its orientation is correct; otherwise the IOT magnet assembly will not fit into the transmitter cabinet. As the IOT is being lowered into the magnet assembly, just before the IOT seats into the magnet and the weight of the IOT is still being supported by the hoist, rotate the IOT so the two body water fittings on the output drift tube face the front on the magnet assembly.

When the IOT is seated and oriented properly in the magnet assembly, installation of the cavities may begin. Metric tools and metric hardware for cavity installation are provided by the IOT supplier. Refer to the tube manufacturer's assembly manual for specific procedures to use in unpacking and assembling the IOT cavity circuits.

2.5.8 CPI Klystrode Uncrating and Assembly

CPI Klystrode equipped transmitters do not require a chain hoist for circuit assembly. The Klystrode cavity/ magnet assembly will arrive in two large crates. One will contain a preassembled circuit assembly, the second will contain the tube. Refer to the tube manufacturers assembly instructions for specific procedures to use in unpacking and assembling the Klystrode/cavity/circuit assembly. The circuit assembly will consist of prewired, premounted cavity/circuit assembly. A blank alignment insert will require removal prior to installing the tube. Slide the clamp handle assembly located on the lower magnet mounting plate to the unlocked position. This should allow the shipping blank to be removed. Uncrate the Klystrode tube. Care must be taken to align the bayonet on the tube and water jacket assembly. Carefully insert the tube into the cavity/water jacket assembly. Lock the clamp handle assembly and proceed with the input cavity assembly.

2.5.9 Magnet Assembly Handling and Storage

CAUTION

THE ASSEMBLED IOT/KLYSTRODE MAGNET IS TOP HEAVY AND CAUTION SHOULD BE OBSERVED WHEN ROLLING IT ACROSS THE FLOOR. THE AREA SHOULD BE SMOOTH AND FREE OF ANY DEBRIS WHICH MIGHT INTERFERE WITH THE WHEELS AND CAUSE THE IOT AND MAGNET TO TIP OVER.

The IOT/Klystrode magnet assembly should be kept in a safe and secure area until it is needed for final transmitter installation. It should be kept covered to prevent dust and dirt contamination.

It will be necessary to install the IOT/Klystrode magnet assembly into the amplifier cabinet to determine the height and centering of the RF transmission line breakaway.

2.5.10 Transmitter Transmission Line Height Adjustment

a. Install the top half of the RF breakaway/harmonic filter assembly in the cabinet. An adjustable clamping bracket supports it from four bolt holes in the cabinet top mounting plate, see Figures 2-4 through 2-6. Tighten the band clamps to secure the upper break away assembly in place.
b. Dependent upon output power level the breakaway/harmonic filter assembly will terminate into either 4-1/16"

Table 2-3. System Interconnection Diagrams

Transmitter	AC Distribution	Plumbing Layout	System Interconnection
CD-100P1	839-8200-100	852-9211-100	839-8204-005
CD-200P2	839-8200-200	852-9211-200	839-8204-002
CD-300P3	839-8200-300	852-9211-300	839-8204-003
CD-400P4	839-8200-400	852-9211-400	839-8204-004

(40KW, 50KW) or 6-1/8" (70KW, 100KW). Interconnecting RF line will also be sized accordingly.

c. Roll the IOT/Klystrode magnet assembly into the cabinet.

d. Plug the four color coded IOT tube cables into the color coded banana jacks on the high voltage junction box (in the EEV tube top lid)
The high voltage junction box (in the EEV tube top lid) is normally completed prior to shipment. If the junction box is not connected, refer to section 5 of this manual.

1. The top lid of the CPI tube contains the input cavity, and the grid, cathode, heater, and ion pump contact rings. This assembly is shipped separately and must be connected to the armored cable shield which contains the grid bias, ion pump, filament, and filament/cathode wires. Wires are listed in table 2-4. See CPI tube instruction manual for connection locations.

e. Fasten the EEV tube top lid to the top of the IOT input cavity using the captive screws.

f. Adjust the centering of the upper breakaway by moving the support plate. Adjust the height of the breakaway by adjusting the band clamps on the upper break away support bracket while someone supports the weight on the assembly. The upper breakaway must mate smoothly with the lower section of the breakaway (mounted on the IOT/Klystrode magnet assembly). When properly adjusted, tighten the hardware on the support plate and band clamps.

CAUTION

Be careful not to damage the IOT Output circuit by applying excessive force when connecting the RF system/PA cabinet RF lines.

Table 2-4. Input Cavity Connections In CPI Top Lid Assembly

Function	Wire Number
Heater	wire 0710
Heater/Cathode	Wire 0711
Ground to Chassis	Wire 0119 (for CPI)
Ion Pump	Wire 0720
Grid Bias	Wire 0719
Note: Wire 119 is the grid bias return.	

2.5.10.1 Installation of Optional Patch Panel (Single Amplifier System)

Set the patch panel and mounting frame on the floor under the desired mounting position. Mount and position all-thread rods directly overhead using the plumb bob. Raise the patch panel and frame into position, level, and secure it.

CAUTION

LEAVE PATCHES IN PLACE DURING INSTALLATION TO STIFFEN AND SUPPORT THE PANEL.

2.6 Equipment Interconnections

2.6.1 Interconnecting Transmission Line and Wave guide

Refer to Table 2-3 System Interconnection Diagrams

Because of the relative routing inflexibility of transmission line and wave guide connections and components, it is recommended that transmitter to RF system transmission line be installed before the plumbing and conduit are installed. This will allow some movement of the RF system or the transmitter cabinets for needed alignment without having to disconnect plumbing or

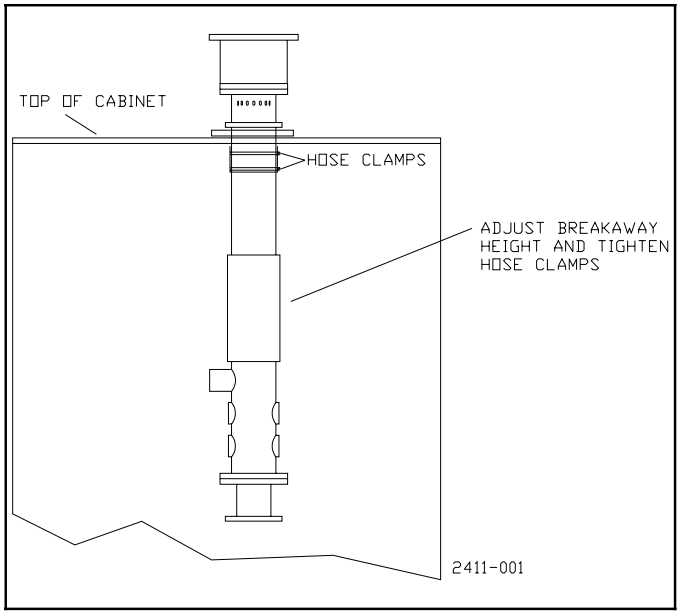

Figure 2-4. Transmission Line Height Adjustment

WARNING: Disconnect primary power prior to servicing.

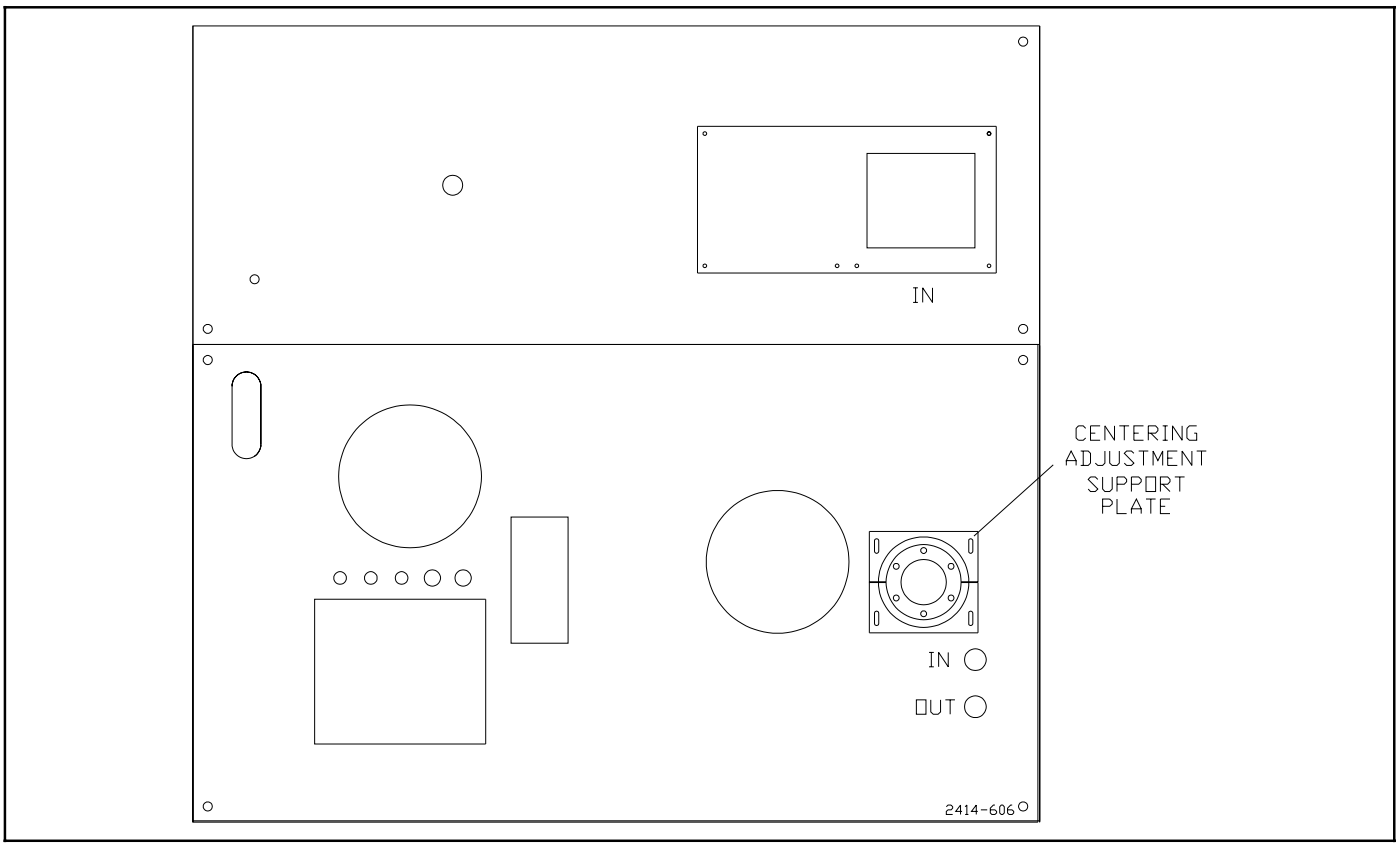

Figure 2-5. Transmission Line Lateral Adjustment

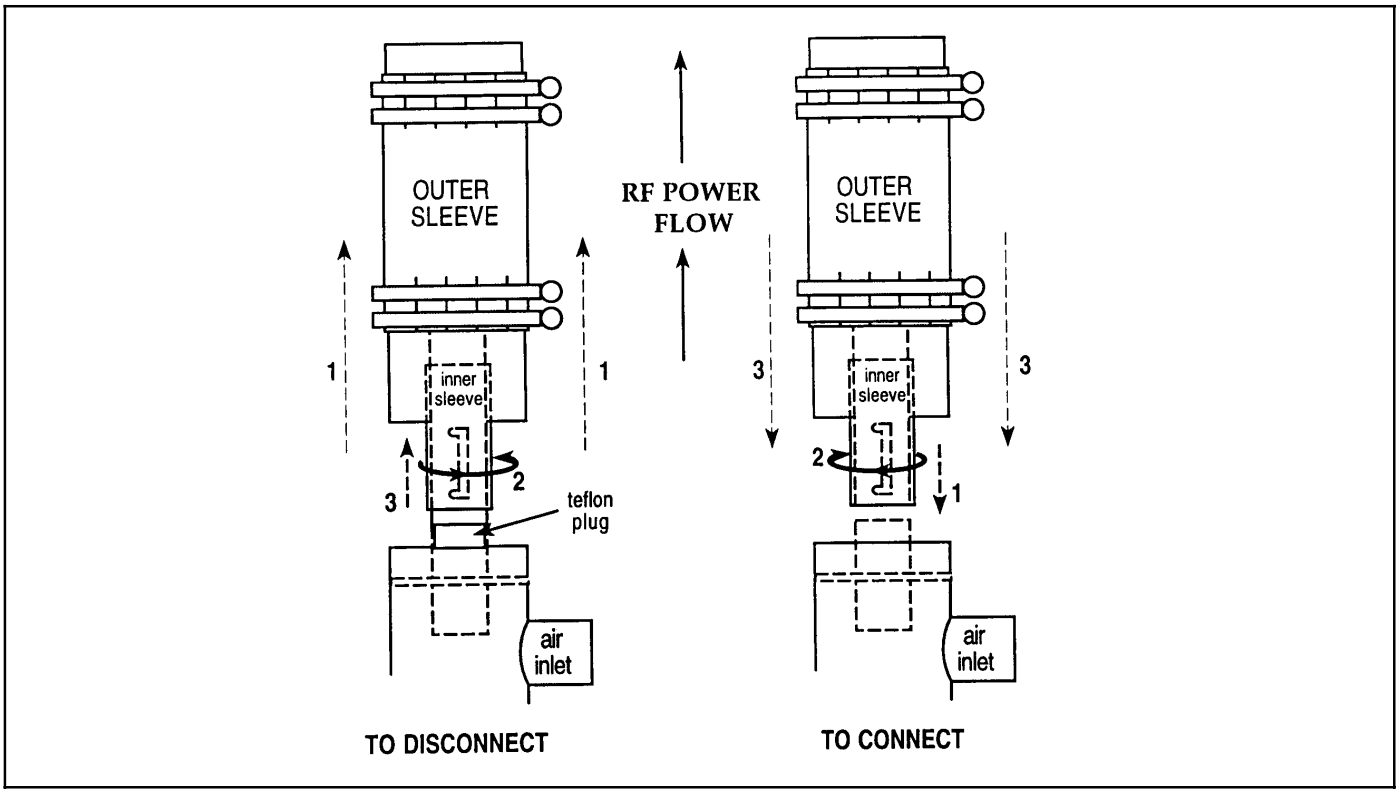

Figure 2-6. RF Breakaway Section Operation

WARNING: Disconnect primary power prior to servicing.

conduit lines. The typical station layout drawing shows one method of proper installation of the transmission line.

NOTE

See Appendix A for specific instructions on how to cut and fit rigid transmission lines.

2.6.2 Preparation For Installing Interconnecting Transmission Line

Before cutting any transmission line, verify that the transmitter and RF system components are correctly positioned and are level. See the applicable typical layout drawings.

Before cutting transmission line for the connection between the amplifier cabinets and the RF system, the correct transmission line vertical height at the top of each transmitter amplifier cabinet must be established. If it has not already been done, temporarily install each IOT/magnet assembly in it's cabinet. Adjust the height and centering of each breakaway to properly connect to the other half of the breakaway mounted to the IOT. This procedure will help compensate for slight variations in the floor level. See Figures 2-4 through 2-6.

NOTE

If 4-1/16" transmission line is used in the installation, a Dielectric to Myatt adapter may be required. This is due to inner conductor diameter differences between the vendors.

2.6.3 RF Line Optimization

Once the RF system and interconnecting transmission line are completed, it is recommended that the system return loss be measured and adjusted if required. The system should be optimized for at least a 30 dB return loss looking from the break away assembly to the system load. System return loss can be adjusted with a fine-matcher line section.

A fine matcher is a short section of rigid line with four adjustable tuning probes installed in it, see Figure 2-7. Tuning probes, used for fine matcher construction, are provided with the installation kit. Four probes are installed at 1/8 wavelength intervals along the length of a short section of line. The distance for 1/8 wavelength is calculated using the formula: spacing (inches) = $1476/F_{MHz}$. Where F_{MHz} = center frequency of the channel. When constructing a fine matcher, drill four holes in the outer conductor of the line and solder nuts over the holes to provide threads for adjusting the depth of the probe.

Four sizes of probes are provided for 6-1/8 inch line. The larger probes are used for lower frequencies, the limiting factor being that the spacing must be greater than the probe disk diameter. The probes provide adjustable shunt capacity every 90 electrical degrees and are used to cancel out reflections that occur a short distance down the line toward the load. Larger probes provide more capacity and can cancel larger reflections. The exact size of probe to use for 6-1/8 inch line is determined by trial. Generally, the smallest size probe capable of achieving the correction is the correct size.

A fine matcher is often installed on the output of each tube and the input of the station test load, but should be used sparingly.

The fine matcher must be within 10 wavelengths of the unwanted reflection. If the distance is greater than 10 wavelengths, the bandwidth of the correction will be too narrow. Also, the correction will be unstable as the temperature of the line changes.

2.6.4 Plumbing System Installation

The plumbing section consists of a single loop, carrying a water/glycol mixture between the outside pump module, heat exchanger, amplifier cabinets and RF system loads.

Use the following information for assistance during installation:

- Refer to typical plumbing layout in conjunction with the list of plumbing kit parts in Section VII (parts lists) or
- A custom plumbing layout drawing.

Install the plumbing system per the drawings. Take care with each solder joint to make sure it is well sealed. Extra time spent making sure solder joints are leak-free will save hours of time later.

See Appendix D for specific information and instructions for cooling system installation and operation.

2.6.5 Guidelines For Installing Cooling System

The following tools and materials are needed:

- Welding torch set
- Oxygen & acetylene tanks
- Welders mask or goggles
- Tubing cutter for 2.5 inch tubing (a hacksaw may be used instead of the tubing cutter)
- Flux (Stay Clean Flux) or equivalent (Harris part number 086 0004 040; one 16 oz bottle provided with plumbing kit)
- Soft silver solder (96.5% tin; 3.5% silver) such as Aladdin #450 (Harris part number 086 0004 038) is needed. Three 1 lb rolls of 1/16 inch soft silver solder is supplied with plumbing kit. 1/8 inch silver solder (Harris part number 086-0004-047) is also available.
- Wire brush and rags
- Water hose

In addition, all thread rod, angle iron or channel, and hangers will be needed to support the plumbing. These are available in an optional installation kit, see Table 2-36 or 2-37.

The copper plumbing lines can be cut with a tubing cutter or a hack saw. Be sure and de-bur the line after cutting.

WARNING

TEMPERATURE OF THE HEATED LINE IN THE FOLLOWING STEPS IS QUITE HIGH. PRECAUTIONS MUST BE TAKEN TO AVOID CONTACT WITH EXPOSED SKIN.

It is recommended that Aladdin 450 soft silver solder (Harris part number 086 0004 038 for 1/16 inch diameter, or 086 0004 047 for 1/8 inch diameter) be used to assemble all plumbing joints. The line, elbows and tees should be cleaned with emery cloth or Scotch Bright before flux is applied for soldering. Since considerable heat is necessary to make the solder flow, some torch black and flaking may develop inside the pipe. Before hanging the line, it is recommended that a hose and wire brush or rag be used to

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clean and flush the inside of the line. This will avoid future problems with plugged filters and fittings due to dirty internal line.

2.6.6 Conduit And Electrical Installation

Although it is not supplied with the **SigmaCD™** transmitter, metal conduit must be used to support and enclose wires connecting each piece of equipment. Any outdoor conduit must be weatherproof. **Plastic conduit is not an acceptable substitution for metallic conduit.**

The 32/36kV high voltage and ground return cables should be run in rigid steel conduit. The high voltage and ground return cables are to be clad in the provided zipper tubing to prevent cable damage during installation. After installing the cable apply the supplied duct seal to the rigid conduit entrance and exit points to prevent moisture intrusion.

EMT is acceptable for interlocks and other AC signals indoors. Refer to the site specific/installation drawings and the standard schematic package for information on conduit installation for the HV beam supplies and line control cabinets. These drawings should also be used to help determine conduit sizes, length of wire runs and fuse/circuit breaker ratings.

The branch feeding the line control cabinet must be a fused circuit as specified in the AC wiring diagram. The instantaneous in-rush current during a crowbar event will typically exceed peak current values of a circuit breaker and in turn generate nuisance trips.

2.7 PA Cabinet Internal Assembly

The front and rear PA cabinets should already be joined together. The following paragraphs will complete the assembly of all internal modules and interconnecting wiring.

2.7.1 Crowbar Assembly Installation

Capacitor C6 must be reinstalled before installation of the crowbar assembly. Refer to sheet 5 of drawing 843-5496-048 (for EEV) or 843-5496-071 (for CPI) for C6 or crowbar connection details.

a. The capacitor is shipped with the white Rulan wire (#733) shorting the capacitor. Wire 733 and a resistor clip remain connected on one end of the capacitor, disconnect the wire from the other end of the capacitor.

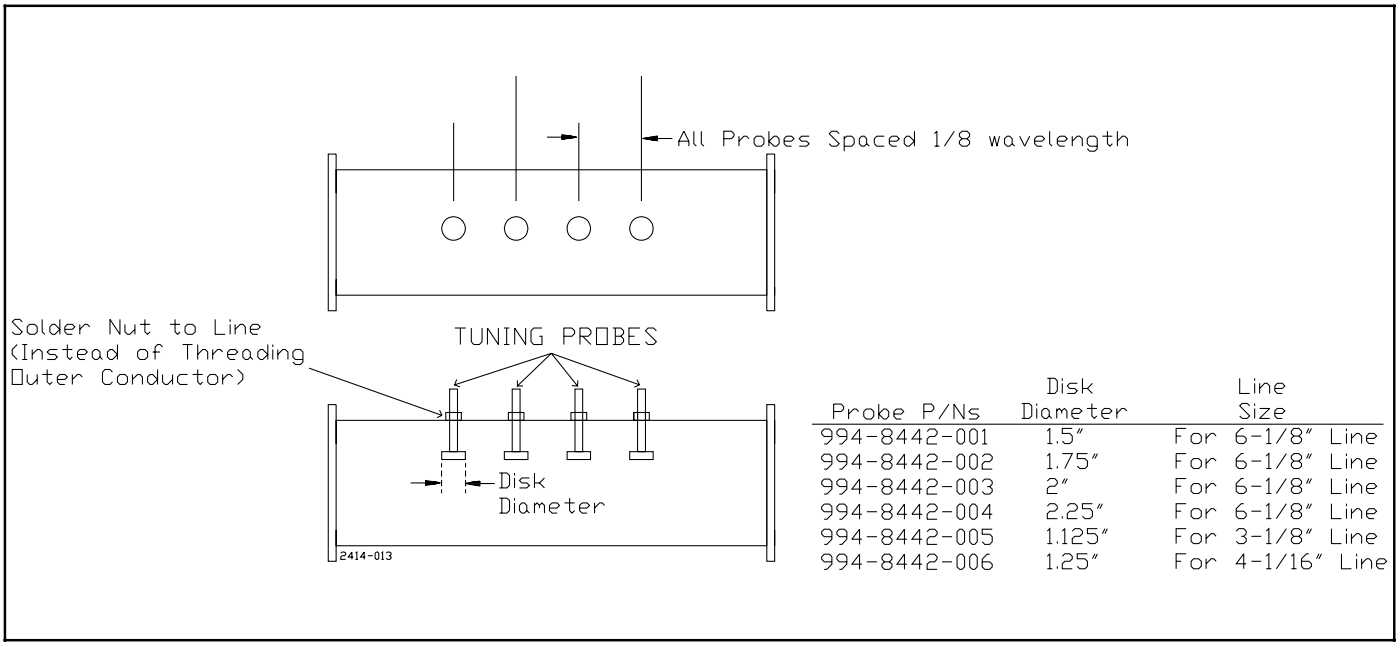
b. The capacitor mounting brackets are installed on the rear PA cabinet wall opposite the center door. Loosen the brackets and slide the capacitor in until it is just visible on the other side of the bracket and tighten the bracket.

c. Reach behind the mounting bracket and connect gray wire (#735) to the capacitor. This wire comes from the body/collector current monitoring assembly.

d. Connect the white Rulan wire (#733) to X4 on the grounding switch. The grounding switch is located above the capacitor.

Facing the rear of the PA cabinet, the crowbar assembly mounts on the right hand wall of the high voltage cubicle. When mounted, the crowbar filament voltage meter is visible through the small window located in the lower half of the right hand rear door.

a. A ground cable, which is fastened to the right cubical wall, is installed under the upper-inside mounting nut.



Probe P/Ns	Disk Diameter	Line Size
994-8442-001	1.5″	For 6-1/8″ Line
994-8442-002	1.75″	For 6-1/8″ Line
994-8442-003	2″	For 6-1/8″ Line
994-8442-004	2.25″	For 6-1/8″ Line
994-8442-005	1.125″	For 3-1/8″ Line
994-8442-006	1.25″	For 4-1/16″ Line

Figure 2-7. Probe Installation, RF Breakaway Section

WARNING: Disconnect primary power prior to servicing.

b. Cap screws must be used to cover the mounting studs after crowbar mounting is complete.

c. Connect the two gray wires (wires 358 and 359) to the output terminals on top of the crowbar filament transformer. Wire #358 to terminal 4 and #359 to terminal 3.

d. Connect the BNC terminated coax cable (wire #337) to the BNC connector on the wall behind the crowbar assembly. This cable comes from the crowbar toroid.

e. Insert R11 into the resistor clips on capacitor C6 and the crowbar assembly.

f. Connect wire #712 to terminal X2 on the isolated supply. This is the -35 kV high voltage output cable from resistors R1 and R2 on the crowbar assembly.

g. Connect wire #736 and the positive lead from the beam supply to the bottom of toroid CT-1. Wire #736 comes from the bottom of the body/collector current monitoring assembly.

h. Connect the negative lead from the beam supply to the stud on the top-far-left side of the crowbar chassis. After connection, this stud must be covered with a cap screw.

i. Connect fiber optic cables 380, 700, and 701 as follows.
#380 to H101 on floating deck unit of crowbar assembly.
#700 (gray) to H2 (gray) on crowbar assembly.
#701 (blue) to H1 (blue) on crowbar assembly.

This completes the crowbar assembly installation. The crowbar assembly is shipped with the thyratron tube installed.

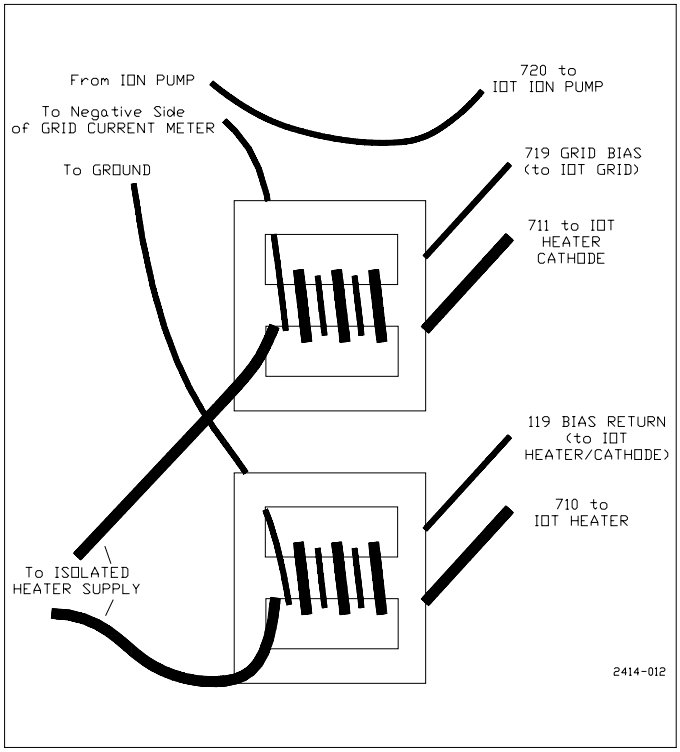

From ION PUMP
To Negative Side of GRID CURRENT METER
To GROUND
720 to IOT ION PUMP
719 GRID BIAS (to IOT GRID)
711 to IOT HEATER CATHODE
119 BIAS RETURN (to IOT HEATER/CATHODE)
710 to IOT HEATER
To ISOLATED HEATER SUPPLY
2414-012

Figure 2-8. T4 and T5 Video Decoupling Toroid For IOT Heater, Grid Bias, and Ion Pump Supplies

2.7.2 Cable and Wire Connections

Refer to the following Front/Rear Cab Analog/Digital schematics: 843-5496-048 for EEV tubes, or 843-5496-071 for CPI tubes. Also refer to 839-8121-771 High Voltage Components and Cables.

2.7.2.1 Rear Cabinet Control Connectors

The following steps will be required to reconnect the front and rear amplifier cabinets since they were separated for shipment. All of the rear connectors are fastened to the wall that separates the front and rear cabinets.

C1 X3, a 16 pin Wego connector, to its wall mounted mate (same number).It is located on left side behind IPA, as viewed from front of the amp cabinet.

C1 X4, a 16 pin Wego connector, to its wall mounted mate (same number). It is located on left side behind IPA, as viewed from front of the amp cabinet.

C1 X1, a 16 pin Wego connector, to its wall mounted mate (same number). It is located on left side behind IPA Feed Forward Assembly, as viewed from front of the amp cabinet.

C1 X5, a BNC connector on wire #96, to bulkhead BNC (C1X7) located on left side behind IPA, as viewed from front of amp cabinet. Wire #337, from crowbar assembly goes to the other side of the bulkhead connector.

C1 X6, a BNC connector on wire #408, to bulkhead BNC (C1X8) located on left side behind IOT trolley, as viewed from the front of the amp cabinet. Wire #338, from body current monitoring assembly goes to the other side of the bulkhead connector.

Be sure the ground wires in the corners, that connect the walls of the front cabinet to the rear wall are reconnected.

Table 2-5. Input Cavity Connections In High Voltage Junction Box (EEV tube top lid)

Function	Jack Color	Wire Number	Wire Termination
Heater	Red	wire 0710	1/4" Term Lug
Heater/Cathode	Black	Wire 0711	1/4" Term Lug
Heater/Cathode	Black	Wire 0119 (for EEV)	1/4" Term Lug
Ground to Chassis		Wire 0119 (for CPI)	
Ion Pump	Blue	Wire 0720	Solder
Grid Bias	Yellow	Wire 0719	Solder
Note: Wire 119 is the grid bias return.			

WARNING: Disconnect primary power prior to servicing.

2.7.2.2 EEV IOT High Voltage Junction Box Termination

The high voltage junction box (in the EEV tube top lid) is normally connected to its umbilical cord prior to shipment. The wires from the other end of the umbilical cord are routed through the video decoupling toroids, as shown in Figure 2-8. The umbilical cable (and top hat) were routed from the rear amplifier cabinet to the front cabinet before the two halves of the cabinet were joined. The following instructions can be used if either the junction box or wires from the other end of the umbilical cord are not connected.

Locate 3/4 diameter black cable bundle, these are the grid bias, ion pump, filament, and filament/cathode connections. Next locate the armored cable shield and install in the opening just below the isolated metering panel located in front of the IOT cabinet. Use extreme care while handling this cable bundle as the black tubing is fragile.

Route the black cable bundle from the rear of the cabinet bulkhead through the armored conduit. Ensure that at least 12 inches of the insulation remain exposed in the rear of the cabinet to prevent arc over. This will provide adequate slack to wrap the cables 3 times through the two ferrite cores (video decoupling T4 and T5 - Dwg 839-8121-771). Refer to Figure 2-8.

Locate the IOT input cavity HV junction box. Remove 5 nylon screws to gain access to the rear of the junction box banana jacks. Insert and secure the armored cable shield to the junction box. Removal of the banana jacks is done in a “push -click -pull” series of movements.

- Push on the banana plug
- A click should be heard/felt
- Pull the banana plug from it’s socket

Ensure the black insulating sleeve of the cable bundle extends 8" beyond the seal tight connector. This should allow the cable to fan out between the base of the junction box and the insulating sleeve. This procedure prevents arc over in the junction box.

2.7.2.3 CPI IOT High Voltage Umbilical Interconnect

The high voltage umbilical cable must be terminated to the Klystrode input cavity. Refer to the CPI IOT instruction manual and drawing 843-5496-771 for connection information.

2.7.2.4 Signal Interconnects

Refer to pages two and three of the following Front/Rear Cab Analog/Digital schematics: 843-5496-048 for EEV tubes, or 843-5496-071 for CPI tubes.

Locate the RF, ALC and reset cables labeled #38, 39, 97 for a single IPA, #1038, 1039, 1097 for the dual IPA, and the fiber optic cables labeled #703,704,702,706,705, 700,701. Route them along the left hand side of the IPA shelf behind the switched meter panel. Next feed them through the rear bulkhead opening under C1X4. Wire #38, 39, 97 will terminate in the rear of the right IPA module connectors LX5, LX6, and LX7 once it is installed. Wire #1038, 1039, 1097 will terminate in the rear of the left IPA module connectors LX5, LX6, and LX7 once it is installed.

Refer to page five of the Front/Rear Cab Analog/Digital schematics: 843-5496-048 (revision Q or later) for EEV tubes, or 843-5496-071 for CPI tubes. Route the terminated fiber optic cables #703, 704, 702, 706, 705, 700, and 701 to the digital analog board top left connectors H13, H12, H14, H15, H16, H1, and H2 respectively. Route gray and blue terminated fiber optics cables #380, #701 and 700 to H101, H1 & H2 of the crowbar Interface assembly (AA) and terminated in respective sockets.

2.7.2.5 Single IPA Install

Refer to Dwg 843-5496-048 or 843-5496-071 Sheet 2.

To install a single IPA locate the circulator support brackets just above the IPA reject loads. Remove the 4 phillips head screws and reverse the orientation of the support bracket so it is extending toward the rear of the amplifier cabinet. Reinstall phillips screws.

Install the IPA module into the slots behind the amplifier control panel located in the front upper left side of the amplifier cubicle. Plug in DC PWR cables wire #803 and 827 to IPA connectors X2/X3 +red and -black connection respectively. Locate the four circulators AQ, AR, AS, and AT. Install in the support bracket located in the rear HV cabinet right hand side over the IPA slot. Connect as shown in schematic 843-5496-048 or 843-5496-071.

Install RF cable W15 between 4 way combiner output AU and probe section U1. The cable will require routing through a 3/4" hole located below and to the left of the reject dump load and heat sink assembly. Locate dump load inputs 5 and 6, feed the two cables through the wall. Terminate circulator C2-3 to input 5 and the 6 dB coupler HB2X3 to input 6. Connect the output of circulator C1X2 to the input of the IOT double slugged tuner/Klystrode RF input connection. Terminate C1X3 to 250 watt reject load R6.

2.7.2.6 Dual IPA Install

Refer to Dwg 843-5496-048 or 843-5496-071 Sheet 3.

To install dual IPA’s complete the single IPA install locate the circulator support brackets just above the IPA reject loads. Remove the 4 phillips head screws and reverse the orientation of the support bracket so it is extending toward the rear of the amplifier cabinet. Reinstall phillips screws.

Install the IPA modules into the left hand slots behind the amplifier control panel located in the front upper left side of the amplifier cubicle. Plug in DC PWR cables wire #1803 and 1827 to IPA 2 connectors X2/X3 +red and -black connection respectively.

Locate the four circulators AQ2, AR2, AS2, and AT2. Install in the support bracket located in the rear HV cabinet right hand side over the IPA slot. Connect as shown in schematic 843-5496-048 or 843-5496-171 or 843-5496-071.

Install RF cable W15 between 8 way combiner output AU and probe section U1. The cable will require routing through a 3/4" hole located below and to the left of the reject dump load and heat sink assembly. Locate dump load inputs 1 , 2, and 3. Feed the three cables through the wall and terminate circulators C2X3 to input 1, C1X3 via W26 to input 3, and the 6 dB coupler HB2X3 to input 2. Connect the output of circulator C1X2 to the input of the IOT double slugged tuner/Klystrode RF input connection.

WARNING: Disconnect primary power prior to servicing.

Table 2-6 System Control Panel Links

* Denotes Link Selection					
Link	Select				Function
X3	*a-b				Solid LED if system normal OK (flashing if not OK)
	b-c				Solid LED if system normal OK (off if not OK)
X21	2TX	3TX	4TX		Circuit illuminates if system is normal.
Link 1	*	*	*		Remove link if single PA system
Link 2		*	*		Remove link if single or two PA system
Link 3			*		Remove Link if single, two, or three PA system
S8	On	1			Close to disable external system normal input
	On	2			Close to disable exciter system normal input
	On	3			Close to prevent local power controls operating in parallel with remotes
	On	4			Close to prevent local system controls operating in parallel with remotes
S12	1	2	3	4	
	Off	Off	Off	Off	Zero reject load meters (single PA system)
	Off	Off	On	On	One reject load meter (two PA system)
	On	On	On	Off	Three reject load meters (three or four PA system)

Table 2-7 System Interface Panel Links

Link	Link	Function
X23		Link if single PA system
X24		Link if one or two PA system
X25		Link if one, two, or three PA system
For USA systems LED should remain extinguished for equipment not in circuit.		
X30	X31	
In	In	Auto Changeover unit present
In	Out	Auto Changeover unit not present
X32	X33	
In		Remote control enable is disabled (single exciter mode)
Out		Remote control enable (dual exciter mode)
	In	
	Out	Auto Changeover selected (dual exciter mode)

WARNING: Disconnect primary power prior to servicing.

2.8 Sigma™ CD Checkout Procedures

In performing the transmitter checkout procedure the process will be broken up into several steps:

a. Primary power distribution checkout
b. Automatic voltage regulator checkout
c. Cooling system checkout (refer to Appendix D)
d. Transmitter cabinets checkout
e. RF system/transmitter interface checkout
f. RF drive system checkout
g. Amplifier HV application and final tests

WARNING

BEFORE APPLYING PRIMARY POWER, TURN OFF ALL CIRCUIT BREAKERS AND DISCONNECT SWITCHES ON THE POWER DISTRIBUTION SYSTEM, AVR, LINE CONTROL CABINET, CONTROL CABINET, AMPLIFIER CABINET, PUMP MODULE AND HEAT EXCHANGER.

WARNING

PROPER PROCEDURE FOR MEASURING VOLTAGES IN THE FOLLOWING STEPS REQUIRES PRIOR REMOVAL OF ALL POWER, AND GROUNDING OF ALL LOCATIONS WHERE TEST LEADS ARE TO BE ATTACHED OR REMOVED. THE TEST METER IS TO BE LOCATED OUTSIDE THE TRANSMITTER CABINET AND ALL DOORS ARE TO BE CLOSED AND LOCKED PRIOR TO APPLYING ANY POWER.

2.8.1 Automatic Voltage Regulator Checkout

Refer to Vendor Manual.

Energize AVR circuit breaker. Check to ensure output voltage meter calibration is accurate. Adjust regulation window to maintain 480 VAC/380 VAC output +/-2%. Also check to ensure the correction window is within center range. This may require retapping of the mains input transformer. Next check for proper phase rotation. Most AVR's have a phase monitor relay to provide an indication of normal rotation.

2.8.2 Control Checkout

a. Check and set Control Cabinet links as per Table 2-6 System Control Panel Links, and System Interface Links/Jumpers per Table 2-7.
b. Refer to Table 2-8. Measure Power Distribution Board Resistance to ensure proper connection. Control System Power Supply Units will auto-select input voltage. (110/220 VAC)
c. Apply primary power (110 or 220 VAC) to the Control Cabinet from the AC mains disconnect panel.
d. Measure and ensure Control Cabinet Power Supplies are within normal tolerances.

2.8.3 RF System/Mode Controller Checkout

Confirm the correct programming of the mode controller. See Tables 2-31 through 2-35 for the appropriate transmitter configuration. Ensure the RF system interconnects have been completed in accordance with the applicable amplifier interconnect schematic: ie. 1x, 2x , 3x, or 4x amplifiers system interconnection schematic. The power amplifier cabinet numbering sequence is dictated by the RF system input port to which the cabinet is connected. The RF system input ports are labeled PA1, PA2, etc... therefore, PA cabinet 1 is the cabinet that is connected to the RF system input port labeled PA1.

Test the appropriate mode command selections and ensure the RF System will switch to the selected positions and generate the appropriate status read backs.

Table 2-8 Control Cabinet Pre-Tests

Check power distribution board resistances:	Measure	
X1-5 to Ground	0 Ohms	
X1-5 to X1-1	∞	PSU-A
X1-5 to X1-2	∞	
X1-5 to X1-3	∞	
X1-5 to X2-1	∞	PSU-B
X1-5 to X2-2	∞	
X1-5 to X2-3	∞	
Turn on control cabinet and measure:		
X2-9	-24 VDC	
X1-9	-24 VDC	
X1-7	+12 VDC	
X1-8	-12 VDC	
X3-8	+5 VDC	
X2-7	+12 VDC	
X2-8	-12 VDC	
X4-5	+5 VDC	

2.8.4 Line Control Cabinet Checkout

Due to safety considerations and to verify installation wiring, the LCC ac voltage outputs will be checked at TB17 located on top of the PA cabinet.

WARNING

380 AND 480 VOLTS AC PRESENT AT TB17. BE SURE ALL LCC CONNECTIONS ARE INSTALLED CORRECTLY IN THE TERMINAL BLOCK WITH THE WIRE INSULATION EXTENDING BELOW THE SURFACE.

a. Make sure all breakers are turned OFF on the front of the PA cabinet.
b. Energize LCC 200 Amp Fused Disconnect at the distribution panel.
c. Energize LCC Q2 (cabinet power).

WARNING

DO NOT TURN ON BEAM SUPPLY MAIN SWITCH S5 ON LCC.

d. On the rear of the amp cabinet open the shorting switch and energize the cabinet isolator. K1 in the LCC should pull in supplying 380 and 480VAC (60Hz) or 380VAC (50Hz) to the PA cabinet.

e. Remove the metal plate covering TB17 on top of the PA cabinet.

f. Measure the following voltages on TB17:
   1. 480 VAC (60Hz) or 380 VAC (50 Hz) at TB17-1 & 2
   2. 480 VAC (60Hz) or 380 VAC (50 Hz) at TB17-2 & 3
   3. 480 VAC (60Hz) or 380 VAC (50 Hz) at TB17-3 & 1.

g. With an ohmmeter, check for continuity from TB17-21 (3-phase present status line) to TB17-11 (ground).
   1. **3 Phase Okay:** If the 3 phase sensor in the LCC is satisfied, TB17-21 will be grounded. To verify that it is not just a wiring short, de-energize Q2 on the LCC and TB17-21 should read open.
   2. **3 Phase Out of Rotation**: If TB17-21 initially reads open (with the power on) and the previous voltage checks were okay, then it will be necessary to de-energize the 200 Amp disconnect at the distribution panel and swap 2 of the 3 phases going to the LCC.

h. Energize the 200 Amp disconnect at the distribution panel, and Q2 (cabinet power) and Q3 (control) on the LCC. Measure the following: (for 480VAC systems, re-tapping of the step down transformer in the LCC may be required)
   1. 380 VAC input TB17-4 & 5
   2. 380 VAC input TB17-5 & 6
   3. 380 VAC input TB17-6 & 4
   4. 220 VAC input TB17-4,5,6 to TB17-7 (neutral)

2.8.4.1 Indicator LEDs

Turn on the Q1 (Control) breaker on the front of the PA cabinet. The following is a list of indicators that should be illuminated.

NOTE

No fault indicators should be illuminated. To clear fault indicators, press fault reset and lockout reset.

a. **Amplifier Control Panel**
   1. AC present
   2. Internal interlock
   3. Local, If not press local control command

b. **Logic & Control PCB**
   (Item "N" on Figure 6-3 component designator view)
   1. Connector interlocks H1

c. **Analog/Digital Interface PCB**
   (Item "P" on Figure 6-3 component designator view)
   1. Power OK H3 (+24V, +/-12V, and +5V).
   2. -12V OK H4
   3. +24Vdc OK H5
   4. +12V OK H6
   5. Internal interlocks OK H7 (IOT top lid interlock)
   6. Rear PA Cabinet Door Interlocks OK H8.

2.8.4.2 Check Interlocks

a. Check the panel interlock circuit to ensure that removal of the rear cabinet doors extinguish the door interlock LED (H8). Replace all panels and doors.

b. Check the IOT top lid interlock circuit to ensure that removal of the IOT top lid extinguishes the internal interlock LED (H7).

c. Connector interlock circuit LED H1 should be illuminated. This indicates that each of the appropriate printed circuit board connections and various other interconnections are made. See Figure 2-9for a simplified schematic of the connector interlocks.

d. De-energize PA cabinet control breaker Q1.

e. On the rear of the amp cabinet, de-energize cabinet isolator switch and close the shorting switch.

f. Turn LCC circuit breakers to OFF and de-energize the 200 Amp disconnect for the LCC.

2.9 System Checkout

2.9.1 Setup TX Output Feeder Probes

Directional couplers should be factory adjusted. If it is determined a need for adjustment is required use a network analyzer to establish the correct coupling ratio and directivity. Refer to Tables 2-9 and 2-10.

2.9.2 Amplifier Cubicle PCB links

Ensure logic PCB switches are correctly set, see Table 2-11, and the links on analog/digital interface PCB and logic PCB are set to correct position, see Tables 2-12 and 2-13.

2.9.3 Functional Checks

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

2.9.3.1 3 Phase supply Present

a. Turn off the LCC 200 Amp fused disconnect.

b. Disconnect either fuse F2 or F3, (2.0 Amp) in the line control cabinet feeding 3 phase power to the power line monitor A2.

c. Engage the LCC 200 Amp fused disconnect and ensure that LCC circuit breakers Q2 and Q3 are engaged.

d. The green ac present LED on the logic board should go out along with all other indications on the logic unit.

e. Deenergize LCC 200 Amp fused disconnect and replace fuses in the LCC.

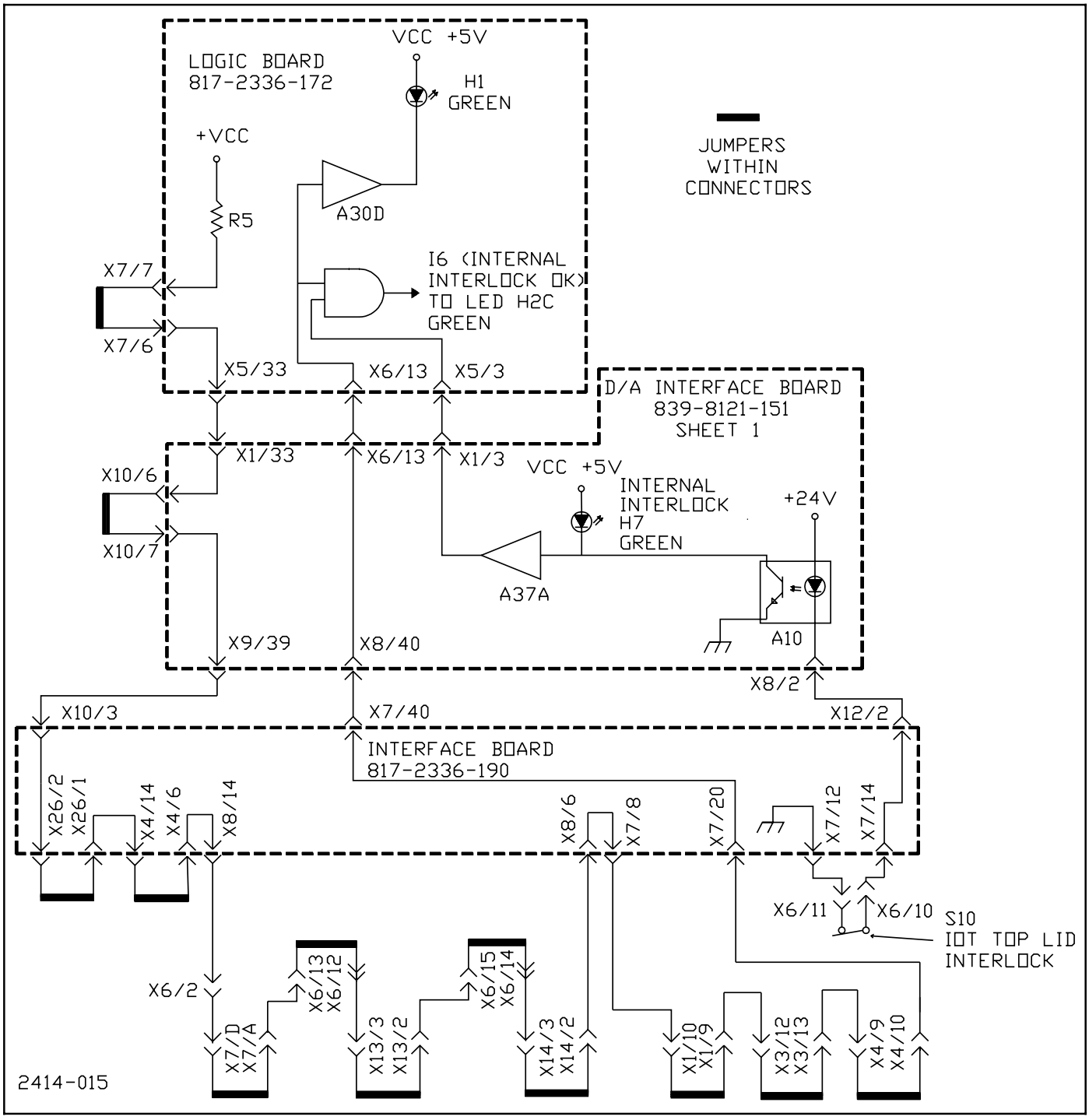


Figure 2-9. Connection Interlocks

WARNING: Disconnect primary power prior to servicing.

Table 2-9. DTV average power

Probe	Function	Sample Powe Level	System Power Level	
			17 kW average	23 kW average
W1 (138)	Reflected Power	(20 mW at PX17)	-45dB	-46dB
W2 (23)	Forward Power	(100mW at PX16)	-53dB	-54dB
W3 (28)	AGC sample	(2 mW at KX9)	-61dB	-62dB
W4	Custor output monitor probe	(20 mW at probe)	-59dB	-60dB

Table 2-10. Setup IPA O/P power probe

Probe	Function	Power Level	Probe Isolation
U2X3 (22)	IPA output power	(100mW at PX15)	-37dB
U2X4	IPA customer output monitor probe	(20 mW at probe)	-44dB
Feed Forward Probe			
UIX3 (W14)	IPA amp O/P to 3 dB hybrid	(100mW at probe)	-37dB

f. Energize LCC 200 Amp disconnect. Turn on Q1 (control) breaker on the PA cabinet.

2.9.3.2 Cabinet Temperature

The two cabinet thermostats S4 and S5 are connected in series and are located on the wall between the IPA cubicle and the IOT cubicle. To check the cabinet temperature circuit, perform the following steps.

a. Remove the spade connector from the thermostats
b. The cabinet temperature LED should illuminate
c. The lockout LED illuminates
d. Transmitter trips off and, depending on jumper setting, performs a lockout to Off, BK Heat, or Standby.
e. Reconnect spade lug to thermostats
f. Reset lockout and LEDs

2.9.3.3 Collector Over-temperature

Note

Refer to Table 2-16 for Digital and Analog Interface (D/A) PCB potentiometer adjustments.

- Trip set at 70°C

a. Move link X27 on D/A PCB to position b - c.
b. Adjust R238 clockwise so Collector Over-temperature red LED just comes on.
c. Reposition link X27 to a - b.
d. Disconnect lead to Collector output thermostat Y/S1 (Located on the output water pipe underneath the tube trolley).
e. The Collector Over-temperature and Lockout red LED's should light.
f. Reconnect lead to Collector output thermostat Y/S1 (Located on the output water pipe underneath the tube trolley).
g. Reset Lockout and Fault LED

2.9.3.4 Collector Current Calibration/Overload

- Digital Amplification trip 2.5A.

a. Zero meter with 'Set Null' pot R255 on D/A PCB.
b. Connect negative lead of a test power supply (3 amp current limiting) to 5 Amp collector shunt resistor (AM-X2 top) on body/collector current monitoring PCB and positive lead to other end of 5 Amp shunt (AM-X1 bottom).
c. Ensure that the power supply meter is calibrated by using an external current meter in series.
d. Calibrate transmitter collector meter at 2.5 Amps (R240 on D/A PCB. If R240 runs out of range, substitute a new value of resistance for the assembled on test resistor R207 (which is nominally 82K ohms).
e. Set collector trip at 2.5 Amps. (R241 on D/A PCB).
f. Collector current red LED will light.
g. Reset fault indicator

2.9.3.5 Body Current Calibration/Overload

- EEV IOT 50mA

NOTE

This procedure does not apply to CPI IOT tubes.

a. Zero meter with 'set null' pot R253 on D/A PCB.
b. Connect positive lead of a power supply (current limiting) to R1 (bottom) on body/collector current monitoring PCB and negative lead to other end of R1 (top).
c. Ensure PSU meter is calibrated using an external current meter in series.
d. Calibrate transmitter body current meter to agree with the external current meter (R243 on D/A PCB) and set body current trip to manufacturers spec (R242 on D/A PCB). If R243 runs out of range, substitute a new value of resistance for the assembled on test resistor R234 (which is nominally 47 K ohms).
e. Body current red LEDs on logic PCB will light.
f. Reset fault LED.

WARNING: Disconnect primary power prior to servicing.

2.9.3.6 Cavity Air Checkout

a. Switch on the cavity cooling and IPA cooling circuit breakers Q2, Q5, and Q6 respectively on the contactor and circuit breaker assy.
b. Switch transmitter to Standby.
c. When the blowers come on, ensure that the 3-phase cavity air blower is rotating in the correct direction. If rotating in the correct direction, the cavity air blower output will blow air out, if rotating in the wrong direction, the blower output will suck air in. Power down the transmitter and reverse two of the three blower motor AC connections to reverse the motor.
d. The other PA cabinet fans are operated from single phase AC power. The only way these fans could blow air in the wrong direction is if they were installed backwards. The two rear cabinet fans should draw air into the rear cabinet, and the two top front cabinet fans should exhaust air out of the cabinet.
e. Test the air pressure switches by removing the nylon sample hoses from the IOT air supply pipes and from the IPA fan enclosure (below the IPA modules).The cavity air and IPA air green LEDs should extinguish when the sample hoses are removed and should illuminate when the sample hoses are reconnected. Ensure air filters are installed and clean for this adjustment.

2.9.3.7 Collector Cooling

Adjust the IOT body and collector flow rates and flow sensors using the following procedure.

a. Turn on AC power breakers and disconnects for the pump and head exchanger modules.
b. Switch the transmitter to standby.
c. Open the rear gate valve (located on the right hand wall of the front cabinet) and adjust the water flow through the body to manufacturers nominal flow rate using front flow meter.
   (CPI tubes do not use liquid cooling for the tube body).
d. Monitor red LED on the bottom of the hall effect relay and adjust the body flow hall effect relay so the contacts just close. The LED will illuminate.
e. Open the collector input (front) gate valve and adjust flow through the collector to manufacturers nominal flow rate using the rear flow meter.21
f. Monitor red LED on the bottom of the hall effect relay and adjust the collector flow hall effect relay so the contacts just close. The LED will illuminate.
g. When both relays are closed ensure the green collector cooling LED is on.

2.9.3.8 EEV and CPI Minimum Coolant Flow Rates

See Table 2-14 or 2-15 and refer to tube vendor data. With the transmitter still in standby, use the following procedure to ensure that the hall effect relay drops out when minimum flow is reached.

a. Using the appropriate gate valve, reduce each flow rate to the recommended minimum flow rate.
b. The appropriate hall effect flow sensor relay should drop out and its red LED extinguish.
c. If not, adjust the position of the relay until it is in for normal flow and drops out at minimum flow.

2.9.3.9 External Interlocks

Check the external interlock path to ensure that all external switches are operational. The external interlock path starts from RX27/1 & 2 on each power amplifier cabinet and connects to an appropriate input of the interlock marshalling board in the transmitter control cabinet. Lines from the interlock marshalling board connect to the interlock switches in the locations listed below. Refer to the power amplifier and transmitter system interconnect drawings. External interlock switches include:

a. Beam supply front access cover
b. Beam supply shorting switch
c. Beam tap switch cover
d. RF system mode switches
e. Cooling system flow switches
f. Filter reject load thermal switches.

RX27 pin 2 is ground. The series connected external interlock switches complete this ground connection to RX 27 pin 1 on the amplifier cabinet interface board. When RX27 pin 1 is pulled to ground,external interlock (I7) goes high and logic board green LED H3G illuminates. I7 is one of the inputs to the logic board ready command.

2.9.3.10 Motor Overload:

The motor overload protection for the cavity fan consists of an overload sensor attached to contactor K1 in the contactor and circuit breaker assembly.

The transmitter should be switched off and isolated.

a. With an ohmmeter check that the logic output contacts from the breaker go from short circuit to open circuit when the test button on the motor overload breaker is pressed.
b. Set cavity blower overload relay K1 to 2.5 Amps.
c. Set the motor overload breaker to auto and remove the logic output wire from the breaker trip connection.
d. Replace the safety cover and after reapplying power to the transmitter select standby.
e. The transmitter should not run up, but indicate motor overload on the amplifier control panel.
f. Switch the amplifier to off again and isolate.
g. Access the circuit breaker assy and replace wire removed in step c, replace the safety cover and after reapplying power to the transmitter select the standby command.
h. Reset Lock out and Overload faults.
i. The transmitter should now run up without indicating motor overload on the amplifier control panel.

WARNING: Disconnect primary power prior to servicing.

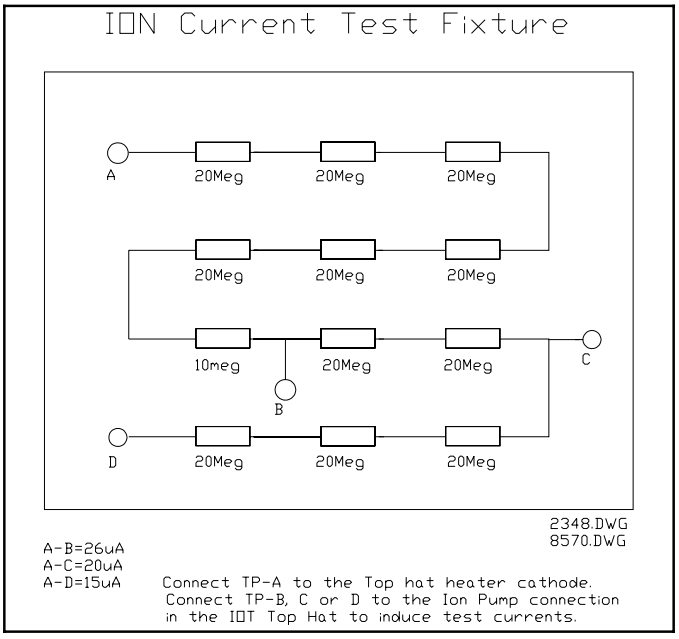


Figure 2-10. Ion Current Test Jig

WARNING

PROPER PROCEDURE FOR MEASURING VOLTAGES IN THE FOLLOWING STEPS REQUIRES PRIOR REMOVAL OF ALL POWER AND GROUNDING OF ALL LOCATIONS WHERE TEST LEADS ARE TO BE ATTACHED OR REMOVED. ALL DOORS ARE TO BE CLOSED AND LOCKED PRIOR TO APPLYING ANY POWER.

2.9.3.11 Ion Current (Calibration/Overload)

No calibration pots exist for the ion current metering and overload circuits. This test only checks the function of the circuit. This circuit was tested and calibrated in the factory.

The ion current test fixture, shown schematically in Figure 2-10, must be constructed in the field if this test is to be performed.

a. Connect the ion current test fixture across the ion current supply. The connection points are the isolated supply chassis and the negative terminal of the ion current meter.
b. Set resistor tapping point so Ion meter reads just below 20 uA. Use test fixture terminals A and D, for 15 mA.
c. Switch on Ion, bias circuit breaker Q3.
d. Ensure ion current green LED lights when the transmitter is on standby.
e. Above 20 mA, the ion pump green LED on the logic is extinguished. The ion current trip and red LED on the logic are active when the transmitter is switched to beam and are disabled in standby. Use test fixture terminals A and B, for 26 mA.
f. Reset Lockout and fault indicators.

WARNING

PROPER PROCEDURE FOR MEASURING VOLTAGES IN THE FOLLOWING STEPS REQUIRES PRIOR REMOVAL OF ALL POWER AND GROUNDING OF ALL LOCATIONS WHERE TEST LEADS ARE TO BE ATTACHED OR REMOVED. THE TEST METER IS TO BE LOCATED OUTSIDE THE TRANSMITTER CABINET AND ALL DOORS ARE TO BE CLOSED AND LOCKED PRIOR TO APPLYING ANY POWER.

2.9.3.12 Bias Current (Calibration/Overload)

Trip points:

- EEV IOT 80 mA
- CPI IOT 120mA

a. Remove the cover on the isolated supply.
b. Connect a 1 K ohm 50 watt resistor between grid current meter negative terminal and the shield of the grid bias supply coax (wire number 727). The shield connects to R1, which is the voltage dependant resistor mounted above the bias current meter.
c. Turn the transmitter to standby and adjust the grid current to manufacturers maximum grid current level using the bias volts adjustment pot on the Isolated Meter assembly. The meter should be reading negative.
d. The logic supplies' bias volts green LED should just go out. If not, refer to Section V, Maintenance and Alignments for Bias Current Calibration.

NOTE

The red bias current trip LED on the logic is disabled in standby.

e. Reducing the bias current to below the trip level will light the bias volts green LED again. (This circuit has a small amount of hysteresis)
f. Return the bias volts adjustment pot to fully CW.

2.9.3.13 IPA Power Supply Set-up And Balance

A PA cabinet can be set up with one or two 1kW IPA amplifier modules. If one IPA module is used, two 32 volt IPA power supplies will be installed. These supplies are powered through breakers Q7 and Q8. If two IPA modules are used, three IPA power supplies are used. These supplies are powered by breakers Q7, Q8, and Q9. The positive dc outputs of the two or three supplies are combined through a paralleling assembly (F) which consists of diodes V1, V2, and V3, shown on sheet 7 of diagram 843-5496-048 (or 071). Use the following procedure to set up and balance the IPA power supplies.

a. Disconnect the dc input leads to the 1kW IPA amplifier(s) and to the 40 watt feed forward amplifier.
b. Set the transmitter to standby.
c. Switch on IPA power supply 1 breaker Q7.
d. Check that 32Vdc is present at the IPA module(s) dc supply connectors and that the polarity is correct. The larger hole in the block is the positive terminal.
e. Switch off Q7, switch on power supply 2 breaker Q8 and repeat step d.
f. For dual IPA installations, switch off Q8, switch on power supply 3 breaker Q9 and repeat step d.

g. Ensure all IPA power supply breakers (Q7 through Q9) are switched off.
h. Reconnect the dc supply connector to IPA module 1.
i. Switch on power supply 1 (Q7) and measure the voltage at the center stud of the PSU paralleling assembly (F)
j. Set the output of the power supply to 32 +/-0.01 Vdc using the output level pot at the bottom front of the power supply.
k. Switch off Q7, switch on power supply 2 breaker Q8 and repeat step j.
l. For dual IPA installations, switch off Q8, switch on power supply 3 breaker Q9 and repeat step j.
m. Switch on all power supply breakers (Q7 through O9). The voltage should be 32 +/- 0.05 Vdc.
n. Check that the IPA volts front panel LED is illuminated and that the LED goes out if any of the supplies are switched off.
o. Switch off all IPA power supply breakers (Q7 through Q9).
p. Reconnect the dc supply to the 40 watt amplifier and IPA module 2 (if fitted).

2.9.3.14 Filament Check

a. Ensure transmitter operational delay times are switched in on the Logic PCB. Refer to Table 2-10.
b. Switch on breaker Q4 (IOT heater) and turn the transmitter to Standby.
c. Wait until the filament voltage has stabilized (at least 20 seconds) making sure the filament step start has completed. Using the full filament voltage rheostat, adjust the filament voltage to the value specified in the IOT data sheet for that particular tube.
d. For the CPI IOT adjust the heater current such that the current is the same as that specified in the CPI IOT test data sheet.
e. Switch the transmitter to BK heat and adjust the filament BK heat voltage rheostat to 1.5 volts below tube manufacturers recommended filament voltage.
f. In no circumstances should the BK heat voltage be less than 5.5 volts.

2.9.3.15 Ion Pump Current Check

While on standby, monitor the Ion pump current. If it is over 20 mA, continue to operate on standby until the current drops. Ion pump current results from gas within the tube, which causes arcing and crowbars when beam voltage is on.

CAUTION

Do not operate the IOT in standby for more then 30 minutes at a time. For longer periods of operation with filaments but no beam voltage, set the transmitter to bk heat.

If the tube has been in storage for some time, it may be quite gassy.

2.9.3.16 Focus Current Adjustment

Use the following procedure to check the setting of the over and under focus current trip points and to set the proper value of focus current.

a. Switch on focus circuit breaker Q10 on contactor & circuit breaker assembly.
b. Switch the transmitter to standby. The full heater LED will light in approximately 20 sec bringing the focus contactor with it.
c. Increase the focus current to the maximum specified focus current as per manufacturers data sheet (EEV IOT 40KW tube 25A, 60KW tube 26A) (CPI IOT 23A). The Focus Current pot is located on the left-hand wall in the IOT compartment.
d. Adjust the focus over-current pot R1 so the FOCUS CURRENT green LED on the front panel just goes out. R1 (and R2) is located inside the PA cabinet behind the contactor/breaker panel on a shelf just above the IPA supplies.
e. Reduce the focus current to the minimum specified focus current as per the manufacturers data sheet (EEV IOT 40 KW tube 20A, 60 KW tube 22A.) (CPI IOT 18A) and turn the under-current pot R2 so the FOCUS CURRENT green LED just goes out.
f. Re-adjust the focus to its nominal operating current as per the manufacturers data sheet. (EEV 23A, CPI 20A)

2.9.3.17 Cavity Arc

a. Press primary cavity arc button located on the front of the contactor and circuit breaker panel and ensure primary cavity arc red LED lights.
b. Press secondary cavity arc button located on the front of the contactor and circuit breaker panel and ensure output cavity arc red LED lights.

2.9.3.18 3 or 4 Shot Overloads

WARNING

DO NOT TURN ON BEAM SUPPLY SWITCH S5 on LCC.

Logic board link X20 determines whether three or four overloads will lock out the PA cabinet, see logic schematic 817-2336-172 sheet 7. X20 position a-b requires four shots to lockout and position b-c is the three shot position.

a. On the amplifier cabinet press BEAM.
b. Depress the cavity arc test button 4 times allowing the transmitter beam/HV contactors to come back in after the individual trips.
c. On the 4th trip the PA should Lockout, and the red Lockout LED should light.
d. Reset lock out and fault LEDs

2.9.3.19 HV Step Start. (2nd step fail)

a. Move link X26 (HV second step disable) on Logic PCB X26 from b-c (normal operation) to a-b (test).
b. Press BEAM.
c. After HV 1st step contactor comes in the PA will trip off and the red HV step start and lockout LEDs will light.
d. Refit link X26 on the logic PCB to position b-c.
e. Reset lock out and fault LEDs

WARNING: Disconnect primary power prior to servicing.

2.9.3.20 Crowbar Filament Voltage Check

The following procedure is used to check the crowbar filament voltage.

a. Turn on crowbar filament breaker Q11.
b. Press STANDBY and wait for filament ready LED to illuminate, about 5 minutes.
c. Check the crowbar filament voltage (visible through window in lower half of right rear PA cabinet door). Filament voltage should be 6.3 Vac +/-0.2% (6.17 to 6.43 Vac).

2.9.3.21 Pretuning IOT

Initially set the IOT tuning controls to the numbers from the factory test data sheet. If the IOT has been shipped directly from its manufacturer, pretuning information can be obtained from the data sheets that come with the tube. Tuning controls to be preset include the following.

- Input Cavity Tune
- Primary Cavity Tune
- Secondary Cavity Tune
- Primary/Secondary (Interstage) Coupling Loop
- Output Coupling Loop

2.9.3.22 Crowbar Protection Check

Prior to application of beam voltage to the IOT, the crowbar circuit operation must be checked using the Crowbar Operation Verification test fixture. Refer to the Crowbar Test Fixture Technical Manual, 888-2459-001.

2.9.3.23 First HV Application

This is the first time high voltage is applied to the IOT for an extended period of time. Ensure that the high voltage power supply is set to its lowest output voltage tap.

a. The transmitter should still be in standby from the previous step. If not, set transmitter to standby and wait approximately 5 minutes (until the delay led has illuminated).
b. Set the IOT bias to 140 volts.
c. Set the transmitter to transmit.
d. After running the IOT at reduced high voltage for 15 to 30 minutes decrease the bias voltage until the IOT quiescent current is 0.3 amps.
    1. If crowbars occur during this time, the IOT may have to be operated at black heat for several hours to remove residual gas.
    2. At the lowest tap, the beam voltage may be insufficient to allow an IOT quiescent current of 0.3 amps.
e. In this step, the high voltage is increased by setting the beam supply to the next higher tap.
    1. Shut down the transmitter, remove all power from the system, set the beam supply to the next higher voltage tap and replace the cover.
    2. Re-apply power to the system, set the transmitter to standby, and wait for filament ready LED, about 5 minutes.
    3. Reset the bias to 140 Vdc.
    4. Set the transmitter to transmit.
    5. After running the IOT at this tap for 15 to 30 minutes decrease the bias voltage until the IOT quiescent beam current is 0.5 amps.
f. Repeat step until the beam supply is tapped for the correct voltage.

2.9.3.24 Tube Tuning

This section not yet available.

WARNING: Disconnect primary power prior to servicing.

Table 2-11. Logic and Control Switches

Logic switches:	Switch on	Time
S3 and S4	1, 2, 3 & 8	120 sec
S5 and S6	3, 5, 6 & 8	300 sec
S7 and S8	1, 4, 6 & 7	600 sec

Table 2-12. Digital and Analogue Interface Links
**** Denotes Link Selection***

Link		Position	Function	Schematic 839-8121-151
X11		a - b	Sound notch out	Sheet 4
	*	b - c	Sound notch in	
X12		a - b	Link for amplifier normal remote output latching enabled	Sheet 8
	*	b - c	Link for amplifier normal remote output latching disabled	
X13	*	a - b	Link for reject power remote output latching enabled	Sheet 8
		b - c	Link for reject power remote output latching disabled	
X22 (removed from board)			Link to defeat Panel Interlock	Sheet 6
X24	*		Link when cooling 2 is not used	Sheet 6
X25	*		Link when cooling 3 is not used	Sheet 6
X26 (removed from board)			Link to defeat external interlock	Sheet 6
X27	*	a - b	Link for normal operation	Sheet 7
		b - c	Link for tube over-temperature setup	
X28		a - b	Link for lockout remote output latching enabled	Sheet 8
	*	b - c	Link for lockout remote output latching disabled	
X30	*	a - b	Link for no data stream from IPA	Sheet 4
		b - c	Link for data stream from IPA	
X36		a - b	Analog transmitter operation	

WARNING: Disconnect primary power prior to servicing.

Table 2-13. Logic & Control PCB Links
**** Denotes Link Selection***

Links	Normal = *	Position	Function	Schematic 839-8121-151
X1		a-b	Link for black-heat	Sheet 1
	*	b-c	Link for background heat	
X2	*	a-b	Link for lockout output latching disabled	Sheet 14
		b-c	Link for lockout output latching enabled	
X3	*	a-b (left)	Link for amplifier normal not AND with ready	Sheet 1
		b-c	Link for amplifier normal to AND with ready	
X4	*	a-b (left)	Link for reject power to AND with ready	Sheet 1
		b-c	Link for reject power to AND with ready	
X8		a-b	Link for amplifier normal output latching enabled	Sheet 14
	*	b-c	Link for amplifier normal output latching disabled	
X9	*	a-b	Link for reject power output latching enabled	Sheet 14
		b-c	Link for reject power output latching disabled	
X10	*	a-b	Link for lockout to off	Sheet 2
		b-c	Link for any other	
X11		a-b	Link for lockout to black	Sheet 2
	*	b-c	Link for any other	
X12		a-b	Link for lockout to standby	Sheet 2
	*	b-c	Link for any other	
X13		a-b	Link for Amplifier Panel controls always active	Sheet 2
	*	b-c	Link for Amplifier Panel controls when LOCAL is off	
X14	*	a-b	Link for open collector remote inputs	Sheet 3
		b-c	Link for TTL remote inputs	
X15		a-b	Link for 5V-12V open for 12V-24V	Sheet 3
X16		a-b	Link for 5V-12V open for 12V-24V	Sheet 3
X17		a-b	Link for 5V-12V open for 12V-24V	Sheet 3
X18		a-b	Link for 5V-12V open for 12V-24V	Sheet 3
X19		a-b	Link for 5V-12V open for 12V-24V	Sheet 3
X20		a-b	4 shot	Sheet 7
	*	b-c	3 shot	
X21	*	a-b	Cavity arc 2. (3 shot)	Sheet 7
		b-c	Cavity arc 2. Single shot	
X22	*	a-b	Reflected power. (3 shot)	Sheet 7
		b-c	Reflected power. Single shot	
X23	*	a-b	Reject power. (3 shot)	Sheet 7
		b-c	Reject power. Single shot	
X24		a-b	Amplifier normal (3-shot)	Sheet 7
		b-c	Amplifier normal (Single Shot)	
X25	*	a-b	Cavity arc 1. (3 shot)	Sheet 7
		b-c	Cavity arc 1. Single shot	
X26		a-b	HV 2nd step fail test	Sheet 13
	*	b-c	Normal operation	
X27	*	a-b	Link for crowbar fired (3/4 shot)	Sheet 7
		b-c	Link for crowbar fired single shot	
X28	*	a-b	Link for separate local and remote controls	Sheet 16
		b-c	Link for local control overides remote controls	

WARNING: Disconnect primary power prior to servicing.

Table 2-14. EEV Minimum Coolant Flow Rates

		distilled	glycol/mix		distilled	glycol mix
IOTD240	Body 4	LPM/1.1 GPM	5 LPM/1.5 GPM	Collector	27 LPM/ 7 GPM	31 LPM/ 8 GPM
IOTD250	Body 4	LPM/1.1 GPM	5 LPM/1.5 GPM	Collector	27 LPM/ 7 GPM	31 LPM/ 8 GPM
IOTD270	Body 4	LPM/1.1 GPM	5 LPM/1.5 GPM	Collector	38 LPM/10 GPM	46 LPM/12 GPM
IOTD2100	Body 4	LPM/1.1 GPM	5 LPM/1.5 GPM	Collector	38 LPM/10 GPM	46 LPM/12 GPM

Table 2-15. CPI Minimum Coolant Flow Rates

		distilled	glycol/mix		distilled	glycol mix
K230W	Body	N/C		Collector	38 LPM/10 GPM	46 LPM/12 GPM
K240W	Body	N/C		Collector	46 LPM/12 GPM	53 LPM/14 GPM
K260W	Body	N/C		Collector	57 LPM/15 GPM	65 LPM/17 GPM

Table 2-16. Digital and Analogue Pot Adjustments

P.C.B.	Potentiometer Functions
R-51	Forward Power Meter Calibrate
R-50	Forward Power Status Trip Point
R-48	IPA Power Meter Calibrate
R-49	IPA Power Status Trip Point
R-46	VSWR Meter Calibration
R-47	VSWR Trip Point
R-238	Tube Overtemp Trip
R-239	High Voltage Meter Calibrate
R-240	Beam Current Meter Calibrate
R-255	Beam Current Meter Zero Set
R-241	Beam Current Overload Trip Point
R-243	Body Current Meter Calibrate
R-253	Body Current Meter Zero Set
R-242	Body Current Overload Trip Point

Table 2-17. Crowbar Specifications

Maximum HT Voltage	40kV
Minimum crowbar firing voltage	5kV
Minimum fault current to fire	50A
Cathode heater voltage & current	6.3 VAC @ 25 A
Reservoir heater voltage & current	6.3 VAC @ 2.0 A
Peak forward anode current	1.5 kA max
Peak reverse anode current	1.0 kA max
Conducted Charge	6.0C max
Thyratron ready signal	Fiber Optic Steady State

WARNING: Disconnect primary power prior to servicing.

Table 2-18. Remote Control Interface
BX6 Command: System Control Cabinet

Pin		Function		Installation Notes
2	*	OFF	Note 1	
3		BK HEAT	Note 1	
4		STANDBY	Note 1	
5	*	BEAM	Note 1	
6	*	RESET	Note 1	
7	*	POWER LOWER	Note 1	
8	*	POWER RAISE	Note 1	
20-37		GROUND		
* = Recommended for Typical Installation				
Note 1: Requires a momentary closure to ground to activate.				

Table 2-19. Remote Control Interface
CX15 Analog Outputs: Control Cabinet

Pin	*	Function		Installation Notes
1		System VSWR	Analog output	
3	*	System RF Output Power	Analog output	
4		Reject Load 3 Power	Analog output	
5		Reject Load 2 Power	Analog output	
6	*	Reject Load 1 Power (A+B)	Analog output	
20-37		Ground		
* = Recommended for Typical Installation				

Table 2-20. Remote Control Interface
CX6 Status: System Control Cabinet

Pin		Function	Note 1	Installation Notes
1	*	Beam	Note 1	
2	*	Standby	Note 1	
3	*	Black Heat	Note 1	
4	*	Off	Note 1	
5	*	Local	Note 1	
6	*	System Normal (overall summary external interlocks)	Note 1	
7		Output Power Normal (Action at aprox 80% power)	Note 1	
8		Reject Load 2 Trip	Note 1	
9		Reject Load 1 Trip	Note 1	
10		VSWR TRIP	Note 1	
11		Amplifier 2 Power Is Normal	Note 1	
12		Amplifier 1 Power Is Normal	Note 1	
14		Local Remote	Note 1	
15	*	Main Exciter fail	Note 1	
20-37		Ground	Note 1	
* = Recommended for Typical Installation				
Note 1: Status outputs are open collector configuration.				

WARNING: Disconnect primary power prior to servicing.

Table 2-21. Remote Control Interface
CX5 Status Outputs: Control Cabinet

Pin		Function		Installation Notes
1		Amplifier 3 Power Normal	Note 1	
2		Amplifier 4 Power Normal	Note 1	
5		Reject Load 3 Trip	Note 1	
10	*	Standby Exciter Failed	Note 1	
20-37		Ground	Note 1	
* = Recommended for Typical Installation				
Note 1: Status outputs are open collector configuration.				

Table 2-22. Remote Control Interface
SX1 Command Inputs: Mode Controler

Pin		Function		Installation Notes
1	*	Mode 1	Note 1	
2	*	Mode 2	Note 1	
3	*	Mode 3	Note 1	
4		Mode 4	Note 1	
5		Mode 5	Note 1	
6		Mode 6	Note 1	
7		Mode 7	Note 1	
8		Antenna	Note 1	
9		Load	Note 1	
20-37		Ground		
* = Recommended for Typical Installation				
Note 1. Requires a momentary closure to ground to activate.				

Table 2-23. Remote Control Interface
SX10 Status Outputs: Mode Controller

Pin		Function		Installation Notes
1	*	Mode 1	Note 1	
2	*	Mode 2	Note 1	
3	*	Mode 3	Note 1	
4		Mode 4	Note 1	
5		Mode 5	Note 1	
6		Mode 6	Note 1	
7		Mode 7	Note 1	
8		Antenna	Note 1	
9		Station Load	Note 1	
10		Local Remote (RF System Only)	Note 1	
20-37		Ground		
* = Recommended for Typical Installation				
Note 1: Status outputs are open collector configuration.				

WARNING: Disconnect primary power prior to servicing.

Table 2-24. Remote Control Interface
RX9 Command Inputs: Amplifier Cabinet

Pin		Function		Installation Notes
1	*	Off	Note 1	
3	*	Black Heat	Note 1	
5	*	Standby	Note 1	
7	*	Beam	Note 1	
9	*	Reset Lockout	Note 1	
11	*	Power Lower	Note 1 (single tube system)	
12	*	Power Raise	Note 1 (single tube system)	
20-37		Ground		
* = Recommended for Typical Installation				
Note 1. Requires a momentary closure to ground to activate.				

Table 2-25. Remote Control Interface
RX2 Analog Outputs: Amplifier Cabinet, Single Tube System

Pin		Function		Installation Notes
1	*	PA Forward Power	Analog output	
2	*	IPA Forward Power	Analog output	
3	*	VSWR	Analog output	
4	*	Beam Voltage	Analog output	
5	*	Collector Current	Analog output	
6	*	Body Current	Analog output	
20-37		Ground		
* = Recommended for Typical Installation				

Table 2-26. Remote Control Interface
RX5 Status Outputs: Amplifier Cabinet

Pin		Function		Installation Notes
1	*	Off	Note 1	
2	*	Black Heat	Note 1	
3	*	Standby	Note 1	
4	*	Beam	Note 1	
5	*	Remote/Local	Note 1	
6		AC Present	Note 1	
7		Internal Interlock	Note 1	
8		External Interlock	Note 1	
9		IPA Air	Note 1	
10		Cavity Air	Note 1	
11		Collector Cooling	Note 1	
12		Black Heater	Note 1	
13		Full Heat	Note 1	
14		Bias Voltage	Note 1	
15		Ion Pump	Note 1	
16		Focus	Note 1	
17		Heater Delay	Note 1	
18	*	Ready	Note 1	
19	*	High Voltage Normal	Note 1	
20-37		Ground		
* = Recommended for Typical Installation				
Note 1: Status outputs are TTL level voltages.				

WARNING: Disconnect primary power prior to servicing.

Table 2-27. Remote Control Interface
RX6 Status Outputs: Amplifier Cabinet

Pin		Function		Installation Notes
1		IPA Volts	Note 1	
2		IPA Power	Note 1	
3		Power	Note 1	
4		Crowbar Ready	Note 1	
5		High Voltage Circuit Breaker (in line control cabinet)	Note 1	
6		2nd Step Complete	Note 1	
7	*	Lock Out (3 Failures)	Note 1	
9	*	Primary Cavity Arc	Note 1	
8	*	Second Cavity Arc	Note 1	
10		Cabinet Temperature	Note 1	
11		HV Step Start	Note 1	
12	*	Collector Current Overload	Note 1	
13		Bias Current Overload	Note 1	
14	*	VSWR Trip	Note 1	
15	*	Body Current Trip	Note 1	
16		ION Pump Trip	Note 1	
17		Tube Over Temperature	Note 1	
18	*	Crowbar Fired	Note 1	
19		Motors	Note 1	
20-37		Ground	Note 1	
* = Recommended for Typical Installation				
Note 1: Status outputs are TTL level voltages.				

Table 2-28. Remote Control Interface
RX32 Status Outputs: Amplifier Cabinet

Pin		Function		Installation Notes
1	*	Amplifier Normal	Note 1	
2	*	Spare	Note 1	
3	*	Output Power Normal	Note 1 (single tube system)	
20-37		Ground		
* = Recommended for Typical Installation				
Note 1: Status outputs are TTL level voltages.				

WARNING: Disconnect primary power prior to servicing.

Table 2-29. Exciter Switcher
Rear Panel Remote Connector J1

Pin			Installation Notes
1	Exciter A Select	Note 1	
2	Exciter B Select	Note 1	
3	Manual Mode Select	Note 1	
4	Auto Mode Select	Note 1	
5	A Mode Status	Note 2, 3	
6	B Mode Status	Note 2, 3	
7	Auto Mode Status	Note 2, 3	
8	Remote Enabled Status	Note 2, 3	
9	Remote Disabled Status	Note 2, 3	
10	A Exciter Faulted	Note 2, 4	
11	B Exciter Faulted	Note 2, 4	
12	Power Raise Command	Not required	
13	Power Lower Command	Not required	
18 - 20	Ground		
Note 1: Requires a momentary closure to ground to activate.			
Note 2. Status outputs configured open collector.			
Note 3: Low = function enabled, High = function disabled.			
Note 4: Low = fault is active.			

Table 2-30. Remote Control Interface
TB2 Pump Module: Commands and Status

TB2-		Function		Installation Notes
1		Pump Run Command (from xmtr)	Note 1	
2	*	Run Alternate Pump Command	Note 1	
3		Coolant Level Low	Note 2	
4		Tank Empty (pump won't run)	Note 2 , 3	
5		Alternate Pump Selected	Note 2	
6		Pump B on	Note 2	
7		Pump A on	Note 2	
20-37		Ground		
* = Recommended for Typical Installation				
One for every cooling package				
Note 1: Requires continuous closure to run.				
Note 2: Status output: contact closure = low, +12V = high.				
Note 3: When pump run command is present, Low = OK and High = empty tank or pump off. If no run command is present, output is always high.				
Note 4: Low = function enabled, High = function disabled.				

WARNING: Disconnect primary power prior to servicing.

Table 2-31
Mode Controller (2 Transmitter System)

Control Selection										
	V1+V2	V1	V2							
	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	TO		
	Pole 1 of SW	Pole 2 of SW	Pole 3 of SW	Pole 4of SW	Pole 5of SW	Pole 6of SW	Pole 7of SW	CLOSE RELAY	Operates	Wire to
S14	ON		ON					K4	PS1-1	X11-1, 2
S13	ON	ON						K5	PS2-1	X11-3, 4
S12		ON						K6	PS1-2	X11-5, 6
S11			ON					K3	PS2-2	X11-8, 7
S10								K2		
S15								K7		
S16								K8		
S17								K9		
S18								K10		
Status Indication/Tally										
	V1+V2	V1	V2	Spare	Spare	Spare	Spare	**S2 has all selections OFF. All unused tallies to have A-H of appropriate switch selected**		
	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7			
S2										
S3	GH									
S4		FG								
S5			EH							
S6				abcdefgh						
S7					abcdefgh					
S8						abcdefgh				
S9							abcdefgh			
Multiplex and Line Stretch latched from Tally Close to associate K11, K15 or K16 with particular mode										
Note: Pole 8 of multiplex/normal switch controls multiplex on Mode 1										
S19	K11 Multiplex selected									
S20	K11 Multiplex deselected									
S21	K15 Line Stretch 1 IN									
S22	K15 Line Stretch 2 IN									
FIXED	TX to Antenna controlled by							K13	X14-7	
FIXED	TX to Test Load controlled by							K14	X14-1	

WARNING: Disconnect primary power prior to servicing.

Table 2-32. Mode Control
(2 Transmitter System + Standby)

Control Selection										
	V1 + V2	V1	V2	V3				Designation		
	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	TO		
	Pole 1	Pole 2	Pole 3	Pole 4	Pole 5	Pole 6	Pole 7	CLOSE		
	of SW	of SW	of SW	of SW	of SW	of SW	of SW	RELAY	Operates	
S10	ON		ON	ON				K2	PS1-1	X11-9, 10
S11		ON						K3	PS1-2	X11-7, 8
S12	ON	ON		ON				K6	PS2-1	X11-5, 6
S13			ON					K5	PS2-2	X11-3, 4
S14	ON	ON	ON					K4	SW-1/1	X11-1, 2
S15				ON				K7	SW-1/2	X13-1, 2
S16										
S17										
S18										
Status Indication/Tally										
	V1 + V2	V1	V2	V3						
	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7			
S2										
S3	DFH									
S4		DFG								
S5			DEH							
S6				CFH						
S7					abcdefgh					
S8						abcdefgh				
S9							abcdefgh			
Note: ABCDEFGH indicates switch towards appropriate character, i.e. NOT visible										
Multiplex and Line Stretch latched from tally Close to associate K11, K15, or K16 with particular mode										
Note	Pole 8 of multiplex/normal switch controls multiplex on Mode 1									
S19							K11 Multiplex selected			
S20							K11 Multiplex deselected			
S21							K15 Line Stretch 1 IN			
S22							K16 Line Stretch 2 IN			
Fixed	TX to Antenna controlled by						K13			
Fixed	TX to Test Load controlled by						K14			
Drg: 817 2336 127										

WARNING: Disconnect primary power prior to servicing.

Table 2-33. Mode Controller
(2 Transmitter System + Emergency IPA mode)

Control Selection										
	EMERGENCY MODES									
		V1+V2	V1	V2	IPA 1,2	IPA1	IPA2		Designation	
		Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	TO	
		Pole 1	Pole 2	Pole 3	Pole 4	Pole 5	Pole 6	Pole 7	CLOSE	
		of SW	of SW	of SW	of SW	of SW	of SW	of SW	RELAY	Operates
S14		ON		ON	ON		ON		K4	PS1-1 X11-1/2
S13		ON	ON		ON	ON			K5	PS2-1 X11-3/4
S12		ON			ON				K6	PS1-2 X11-5/6
S11				ON			ON		K3	PS2-2 X11-7/8
S10		ON	ON	ON		ON			K2	VA1-Pos1X11-9/10
S15						ON	ON		K7	VA1-Pos1 X13-1/2
S16		ON	ON	ON		ON			K8	VA1-Pos2 X13-3/4
S17					ON		ON		K9	VA1-Pos2 X13-5/6
S18							K10			
Status Indication / Tally										
		V1+V2	V1	V2	IPA 1,2	IPA1	IPA2	n/a	Tally	Wire From
		Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7		
S2										
S3		GH							PS1-1	X6-1/2
S4			FG						PS2-1	X6-3/4
S5				EH					PS1-2	X6-5/6
S6					cdgh				PS2-2	X6-7/8
S7						dfg			V1K12	X7-1/2
S8							ceh		V2K34	X7-3/4
S9								abcdefgh		
Note: S2 has all selections switched to the numbered position (OFF)										
ABCDEFGH indicates switch towards appropriate character, i.e. NOT visible										
Multiplex and Line Stretch latched from tally										
Close to associate K11,K15 or K16 with particular mode										
Note: Pole 8 of multiplex / normal switch controls multiplex on Mode 1										
S19									K11 Multiplex selected	
S20									K11 Multiplex deselected	
S21									K15 Line Stretch 1 IN	
S22									K16 Line Stretch 2 IN	
Fixed	TX to Antenna controlled by								K13	
Fixed	TX to Test Load controlled by								K14	
X2	a-b	Local Mode Control does not operate in parallel with remote mode controls.								
X2	a-b	Solid LED when Status= Selection. Flashes if Status <>Selection								
	b-c	Solid LED from Status. Flashing LED from Selection								

WARNING: Disconnect primary power prior to servicing.

Table 2-34. Mode Controller (3 Transmitter System)

Control Selection											
	V1 + V2 + V3	V1 + V2	V1 + V3	V2 + V3	V1	V2	V3	Designation			
	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	TO			
	Pole 1	Pole 2	Pole 3	Pole 4	Pol 5	Pole 6	Pole 7	CLOSE		S/C	S/C
	of SW	of SW	of SW	of SW	of SW	of SW	of SW	RELAY	Operates	X11	X13
S14	ON	ON		ON		ON	ON	K4	PS1-1	1 & 2	
S13			ON		ON			K5	PS1-2	3 & 4	
S12	ON	ON	ON		ON			K6	PS2-1	5 & 6	
S11				ON		ON	ON	K3	PS2-2	7 & 8	
S10	ON	ON	ON	ON	ON	ON		K2	PS3-1	9 & 10	
S15							ON	K7	PS3-2		1 & 2
S16			ON	ON			ON	K8	PS4-1		3 & 4
S17	ON							K9	PS4-2		5 & 6
S18		ON			ON	ON		K10	PS4-3		7 & 8

Status Indication/Tally							
	V1 + V2 + V3	V1 + V2	V1+ V3	V2 + V3	V1	V2	V3
	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7
S2	H						
S3	DFH						
S4		ADFH					
S5			BDFG				
S6				BDEH			
S7					ADFG		
S8						ADEH	
S9							BCEH

Note: ABCDEFGH indicates switch towards appropriate character, i.e. NOT visible			
Multiplex and Line Stretch latched from tally			
Close to associate K11, K15, or K16 with particular mode			
Note:	Pole 8 of multiplex/normal switch controls multiplex on Mode 1		
S19			K11 Multiplex selected
S20			K11 Multiplex deselected
S21	3 on		K15 Line Stretch 1 IN
S22	4 on		K16 Line Stretch 2 IN
Fixed		TX to Antenna controlled by	K13
Fixed		TX to Test Load controlled by	K14

Phase Shifter positions versus System Modes:					
Mode	PSH 1	PSH 2	PSH 3	PSH 4	PHS 1, 2 & 3
V1 + V2 + V3 to Filter	1	1	1	2	Pos 1 out 0°
V1 + V2 to Filter, V3 to R2	1	1	1	3	Pos 2 in 0° 9
V1 + V3 to Filter, V2 to R1	2	1	1	1	
V2 + V3 to Filter, V1 to R1	1	2	1	1	PHS 4
V1 to Filter, V2 to R1, V3 to R2	2	1	1	3	Pos 1 out 0°
V2 to Filter, V1 to R1, V3 to R2	1	2	1	3	Pos 2 -19°
V3 to Filter, V1 to R1, V2 to R2	1	2	2	1	Pos 3 in 90° -
Phase shifter switches in line with wave guide inputs					
Drg. 817 2336 126					

WARNING: Disconnect primary power prior to servicing.

Table 2-35. Mode Controller (4 Transmitter System)

Control Selection										
	V1+V2+V3+V4	V1+V2	V3+V4					Designation		
	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	TO		
	Pole 1 of SW	Pole 2 of SW	Pole 3 of SW	Pole 4 of SW	Pole 5 of SW	Pole 6 of SW	Pole 7 of SW	CLOSE RELAY	Operates	Wire to
S14	ON		ON					K4	PS1-1	X11-1, 2
S13	ON	ON						K5	PS2-1	X11-3,4
S12		ON						K6	PS1-2	X11-5,6
S11			ON					K3	PS2-2	X11-8, 7
S10								K2		
S15								K7		
S16								K8		
S17								K9		
S18								K10		
Status Indication/Tally										
	V1+V2+V3+V4	V1+V2	V3+V4	not used	not used	not used	not used			
	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7			
S2										
S3	GH									
S4		FG								
S5			EH							
S6				abcdefgh						
S7					abcdefgh					
S8						abcdefgh				
S9							abcdefgh			
Note: S2 has all selections switched to the numbered position (OFF) ABCDEFGH indicates switch towards appropriate character, i.e. NOT visible										
Multiplex and Line Stretch latched from tally Close to associate K11, K15, or K16 with parallel mode										
Note: Pole 8 of multiplex/normal switch controls multiplex on Mode 1										
S19							K11 Multiplex selected			
S20							K11 Multiplex deselected			
S21							K15 Line Stretch 1 IN			
S22							K16 Line Stretch 2 IN			
Fixed							K13			
Fixed							K14			

WARNING: Disconnect primary power prior to servicing.

Table 2-36
Installation Kit 4-1/16" Line Systems

CP1	CP2	CP3	CP4	Harris Part Number	Description	
6	9	12	15	358-2160-000	P1000T) SLOTTED CHANNEL, 1-5/8" SQ 20FT	EA
15	23	30	38	358-2179-000	HTHR037) 3/8"-16 THREADED ROD 10’	EA
5	7	10	13	358-2202-000	HRCN037) 3/8"-16 COUPLER NUT	EA
30	45	60	75	358-1131-000	P1008) 3/8"-16 SPRING NUT	EA
15	23	30	38	358-2188-000	P2863) FLAT PLATE FITTING FOR 3/8" BOLT	EA
15	23	30	38	358-1127-000	P1068) TWO HOLE “L” BRACKET 1-5/8 X 2-1/2	EA
50	75	100	125	302-0318-000	3/8"-16 X 1" SS HEX SCREW	EA
0	0	0	0	302-0319-000	3/8"-16 X 1-1/4" SS HEX SCREW	EA
50	75	100	125	302-0320-000	3/8"-16 X 1-1/2" SS HEX SCREW	EA
100	150	200	250	306-0046-000	3/8"-16 SS HEX NUT	EA
100	150	200	250	314-0011-000	3/8" SS SPLIT LOCK WASHER	EA
100	150	200	250	310-0011-000	3/8" SS FLAT WASHER	EA
0	0	0	0	358-1891-000	3/8"-16 LEAD ANCHOR, STAR TAMPIN 4025	EA
0	0	0	0	464-0055-000	SETTING TOOL, STAR TAMPIN 4025-7	EA
0	0	0	0	464-0056-000	MASONRY DRILL, 3/4"	EA
0	0	0	0	359-1053-000	J1220N) HANGER PLASTIC COATED 2" J	EA
0	0	0	0	359-1055-000	J1240N) HANGER PLASTIC COATED 4" J	EA
10	20	30	40	359-1049-000	J1220) HANGER 2" J	EA
6	12	18	24	359-1051-000	J1240) HANGER 4" J	EA
1	1	2	2	086-0004-040	SILVER SOLDERING FLUX, 16 OZ BOTTLE	EA
1	2	3	4	099-0002-238	HARD SILVER SOLDER 1/16"	OZ
1	2	3	4	086-0004-038	SOFT SILVER SOLDER, 3.5% AG	LB

WARNING: Disconnect primary power prior to servicing.

Table 2-37
Installation Kit 6-1/8" Line System

CP1	CP2	CP3	CP4	Harris Part Number	Description	
6	9	12	15	358-2160-000	P1000T) SLOTTED CHANNEL, 1-5/8" SQ 20FT	EA
7	11	14	18	358-2179-000	HTHR037) 3/8"-16 THREADED ROD 10’	EA
2	3	4	5	358-2202-000	HRCN037) 3/8"-16 COUPLER NUT	EA
14	20	27	34	358-1131-000	P1008) 3/8"-16 SPRING NUT	EA
7	11	15	19	358-2188-000	P2863) FLAT PLATE FITTING FOR 3/8" BOLT	EA
15	23	30	38	358-1127-000	P1068) TWO HOLE “L” BRACKET 1-5/8 X 2-1/2	EA
50	75	100	125	302-0318-000	3/8"-16 X 1" SS HEX SCREW	EA
0	0	0	0	302-0319-000	3/8"-16 X 1-1/4" SS HEX SCREW	EA
50	75	100	125	302-0320-000	3/8"-16 X 1-1/2" SS HEX SCREW	EA
100	150	200	250	306-0046-000	3/8"-16 SS HEX NUT	EA
100	150	200	250	314-0011-000	3/8" SS SPLIT LOCK WASHER	EA
100	150	200	250	310-0011-000	3/8" SS FLAT WASHER	EA
0	0	0	0	358-1891-000	3/8"-16 LEAD ANCHOR, STAR TAMPIN 4025	EA
0	0	0	0	464-0055-000	SETTING TOOL, STAR TAMPIN 4025-7	EA
0	0	0	0	464-0056-000	MASONRY DRILL, 3/4"	EA
8	12	16	20	358-1896-000	HTHR050) 1/2"-13 THREADED ROD 10’	EA
3	4	6	8	358-1894-000	HRCN050) 1/2"-13 COUPLER NUT	EA
16	25	33	41	358-1895-000	P1010) 1/2"-13 SPRING NUT	EA
8	12	15	19	358-2472-000	P2864) FLAT PLATE FITTING FOR 1/2" BOLT	EA
100	150	200	250	302-0338-000	1/2"-13 X 1-1/2" SS HEX SCREW	EA
100	150	200	250	306-0034-000	1/2"-13 SS HEX NUT	EA
100	150	200	250	314-0015-000	1/2" SS SPLIT LOCK WASHER	EA
100	150	200	250	310-0026-000	1/2" SS FLAT WASHER	EA
0	0	0	0	358-2168-000	1/2"-13 LEAD ANCHOR, STAR TAMPIN 4035	EA
0	0	0	0	464-0119-000	SETTING TOOL, STAR TAMPIN 4035-7	EA
0	0	0	0	464-0260-000	MASONRY DRILL, 7/8"	EA
0	0	0	0	359-1053-000	J1220N) HANGER PLASTIC COATED 2" J	EA
0	0	0	0	359-1056-000	J1260N) HANGER PLASTIC COATED 6" J	EA

WARNING: Disconnect primary power prior to servicing.

WARNING: Disconnect primary power prior to servicing.

3.1 Introduction

This section describes the operating controls and indicators for Sigma® CD transmitters and the procedures used to turn the transmitter on and off.

Figure 3-1 is a front-view drawing of a single-PA Sigma® CD transmitter. The location of the primary controls — those most frequently used - is the control cabinet on the left-hand side of the transmitter. The System Control Panel at the top of the cabinet contains all transmitter operating controls, and the Mode Control Panel (not used in some single-PA transmitters) controls and monitors any output system switching.

The PA Cabinet, on the right in Figure 3-1, contains an Amplifier Control Panel in the top left front of the cabinet which displays the amplifier's faults, operating status and power levels and which can be used to operate the amplifier independent of the System Control Panel.

The UHF Linearizer, mounted below the Amplifier Control Panel, contains a front-panel meter and meter selector switch which may be used to check IOT tube voltages.

An isolated meter panel displaying PA heater voltage, Ion Pump current and bias voltage and current is mounted at the top rear of the right-hand side of the PA.

The exciter for the transmitter is installed in the control cabinet below the Mode Controller. If two exciters are installed, an exciter switcher is included and is installed between the exciters. Controls on the front panel of the exciter switcher allow the operator to select either exciter to drive the transmitter and also allow him to set the exciter switcher to switch automatically if there is an exciter failure. A Remote Control button on the exciter switcher also allows the operator to enable or disable control from elsewhere.

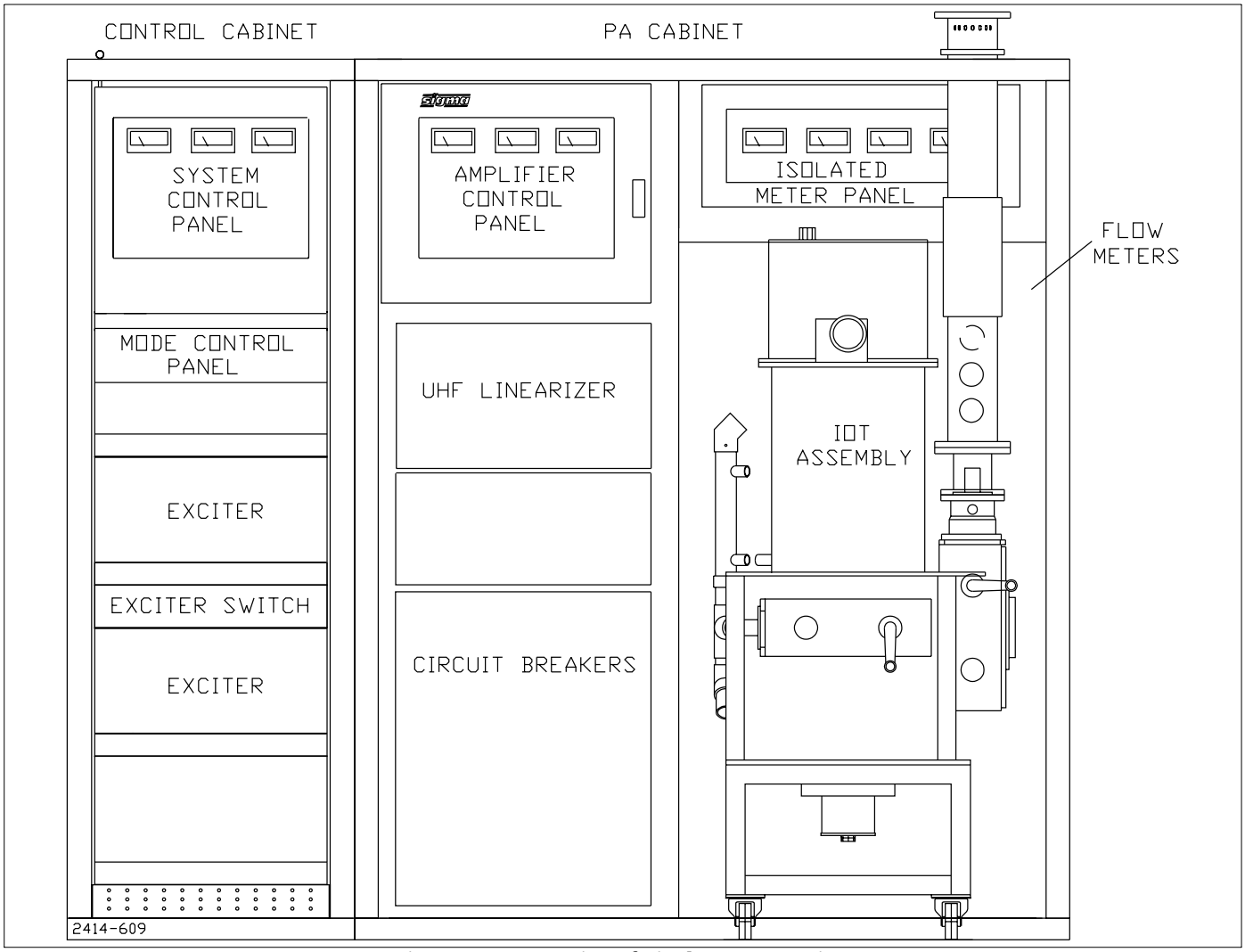


Figure 3-1. Front View of Single-PA Transmitter

WARNING: Disconnect primary power prior to servicing

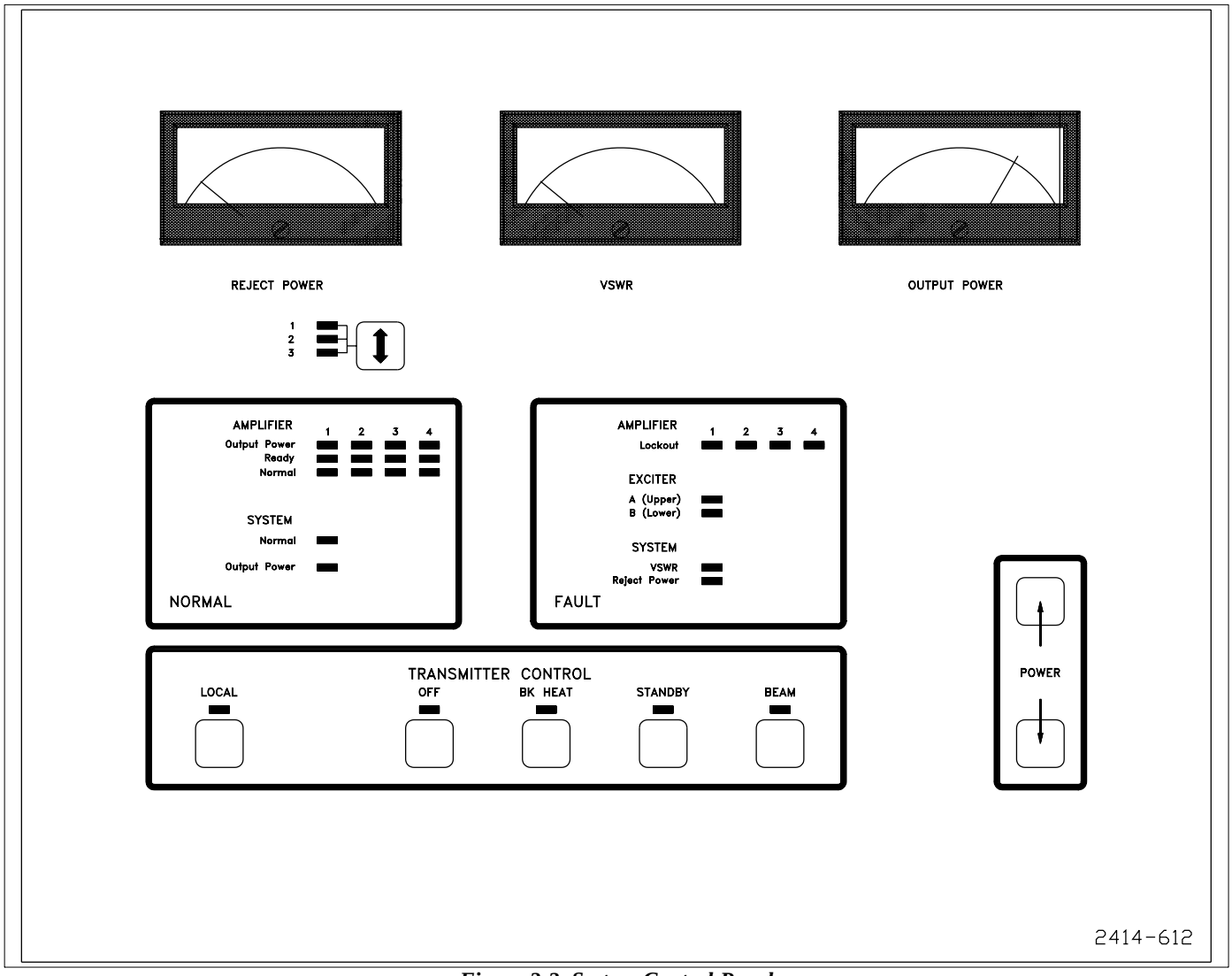


Figure 3-2. System Control Panel

3.2 Routine Operating Procedures

3.2.1 Daily Turn On

a. Press STANDBY at least 5 minutes prior to scheduled air time.

Caution

Operation in STANDBY for more than 30 minutes can damage the IOT tube, and is not recommended.

b. Allow 5 minutes for transmitter to warm up. As the warm-up delay is completed in each amplifier, its' green "Ready" LED lights.

c. Depress BEAM command. The BEAM LED will illuminate, the Line control Cabinet(s) will step-start and the Power meter should begin to indicate output power.

d. Check all meter readings.

3.2.2 Single-Button Daily Turn-On

It is possible to start the transmitter from the OFF condition by pressing BEAM, but if there is more than one PA in the transmitter, the PA cabinets may start at different times, resulting in an erratic start-up.

To avoid this, normal procedure should be as listed in 3.2.1.

3.2.3 Daily Turn Off

a. Depress OFF.

b. All line control cabinets should switch off and RF output should cease.

c. The blowers and pumps should continue running for 5 minutes to ensure proper cool-down of the equipment.

3.2.4 Black Heat or Background Heat

BK HEAT is provided for users who need to operate the IOT with heater on and with beam off for extended periods. This operation is called Black Heat, or Background Heat.

WARNING: Disconnect primary power prior to servicing

A typical use for BK HEAT is operation of a reserve transmitter, kept in readiness for operation if the main transmitter fails.

Selecting BK HEAT reduces the heater voltage to a safe level once the tube has been warmed to operating temperature. For a more detailed description, see BK HEAT in section 3.3.2 below.

3.3 System Control Panel

(See Figure 3-2)

The system control panel provides overall local control of the standard Sigma® CD transmitter system. LED indicators above the control push buttons show the operating state of the transmitter.

3.3.1 Metering

Metering is provided at the top of the panel for these power functions:

- OUTPUT POWER
  Relative output power from the combined transmitter. This meter is calibrated to read 100% when the transmitter is at the intended power level.
- VSWR
  Reflected RF power at the transmitter combined output, displayed in VSWR units. This meter's display is accurate only if the transmitter output power is at 100%.
- REJECT LOAD
  An indication of the power present in the output combining system (magic tee) reject loads. A maximum of three reject loads can be metered. 100% on this meter is set to be the highest power to be encountered with any combination of amplifiers turned off.
  Selection of the desired reject load sample in large transmitters is made by pressing a push-button switch below the REJECT POWER meter. The green LED's next to the button show the current selection.

3.3.2 Operational Mode and Power Control

The System Control Panel has push-button switches to enable selection of:

- STANDBY
  Used to ready the transmitter for operation. Pressing this button starts the amplifier heaters and cooling systems and begins warm-up of the amplifiers. After approximately 5 minutes, the Ready light for each PA illuminates and transmission can commence.
- BEAM
  Turns on the beam power supplies and brings the transmitter to operational mode.
  (If pressed from the OFF mode, the 5 minute STANDBY delay will occur before the beam supplies turn on.)
- OFF
  Shuts down the transmitter by turning off BEAM and starting the 5-minute cool down timer.
- BK HEAT
  Places the transmitter in a BEAM off, reduced heater voltage mode, to be used when a transmitter must be kept ready for rapid start-up for longer than 30 minutes.

  When BK HEAT is selected from OFF, a 30 minute timer is started. After a 30 minute delay, pressing BEAM will place the PA on-air immediately. Pressing BEAM before the 30 minute delay is completed starts the 5-minute STANDBY delay, following which the PA comes on.

  When BK HEAT is selected from the STANDBY mode after the 5-minute STANDBY delay, or from BEAM, the transmitter can be returned to BEAM and full operation with only a 120 second delay.

NOTE

The time delays associated with BK HEAT are in accord with tube manufacturers' specifications. See the most recent data sheets for the tube you are using.

Tube manufacturers specify limits to the time a tube may be operated in BK HEAT, following which a period of operation at full power is required. For example, EEV advises limiting BK HEAT operation to 14 days, following which 7 days' operation at full power is required.

- To the right of the mode buttons, POWER Raise and Lower buttons can be used to adjust transmitter output power.
- A LOCAL push-button and LED in the lower left corner of the panel is used in transmitters with remote control equipment connected, as a means of isolating the transmitter from the remote controls when desired for maintenance security.
  LOCAL on the System Control Panel isolates this panel's operation from remote equipment. The Mode Control Panel and the Exciter Switcher have similar buttons which must be operated to isolate their functions from remote control equipment.

3.3.3 NORMAL Indicators

A group of green LED's displays NORMAL amplifier operational status. These three indicators are also present in the NORMAL group of LED's on each amplifier control panel.

- AMPLIFIER Output Power (Amplifiers 1 - 4)
  — the amplifier's output is higher than 80% of normal.
- AMPLIFIER Ready (Amplifiers 1 - 4)
  — the amplifier's start-up timers are satisfied. Pressing BEAM will turn the amplifier on immediately.
- AMPLIFIER Normal (Amplifiers 1 - 4)
  — the PA cabinet's circuit breakers are all set ON.

The following two indicators signal OK conditions in the control cabinet:

- SYSTEM Normal
  — All AMPLIFIER NORMAL indicators on.
  — All PA's set to remote (LOCAL off).
  — System Control Panel set to Remote (LOCAL off).
- SYSTEM Output Power
  — the total output power from the transmitter is higher than 80% of the normal output.

A group of four red LED's shows amplifier FAULT status:

- AMPLIFIER Lockout (Amplifiers 1 - 4)
  — a fault in the amplifier has caused its lockout to engage. (Lockout can only be reset at the PA cabinet.)

WARNING: Disconnect primary power prior to servicing

These LED indicators signal exciter or system-level faults.

- EXCITER A (Upper) or EXCITER B (Lower)
  — The Exciter is not functioning correctly and should be checked.
- SYSTEM VSWR
  — Reflected power exceeding the VSWR trip level has been detected at the combined output of the transmitter. (Alarm only — no action taken by the system controller.)
- SYSTEM Reject Power
  — Excessive reject load power has been detected in one of the output system reject loads.
  (Alarm only — no automatic action taken. This alarm would signal the need for service or adjustment.)

3.4 Mode Control Panel

In transmitters with more than one PA cabinet, RF output switching is included to allow one or more PA's to be taken off-line for service. A Mode Control Panel is mounted below the System Control Panel to allow operator selection of the RF Output System mode. The Panel contains a single row of push buttons with an LED indicator above each button. The buttons are used to select and confirm the output system operating mode and will be arranged differently in each version of the transmitter.

A transmitter using two PA cabinets might have the following mode control push buttons:

- A + B Air
  Sends the combined PA outputs to the antenna.
- A AIR
  Sends PA "A"' cabinet output to the antenna.
- B AIR
  Sends PA "B"' cabinet output to the antenna.
- TX TO AIR
  The transmitter output is routed to the antenna.
- TX TO LOAD
  The transmitter output is routed to the station test load.
- LOCAL
  Isolates the mode controller from operation by remote control equipment.

NOTE

Mode Control Panel LOCAL is independent of and is not controlled by LOCAL on the System Control Panel.

3.5 Exciter Switcher

If two exciters are installed, an exciter switcher (Figure 3-3) is added between the exciters. The exciter switcher front panel contains EXCITER FAULT A and B indicators, used to trigger automatic exciter switching. The fault signals originate in the exciters.

The panel also contains the following alternate-action push-button controls:

- ON AIR EXCITER SELECT
  When pressed, switches from the currently-selected exciter to the alternate exciter.
- AUTO / MANUAL SELECT
  When pressed, selects MANUAL or AUTOmatic operation of the switcher.
  - In MANUAL operation, exciter selection is controlled only by the ON AIR EXCITER SELECT button.
  - In AUTO, the exciter switcher monitors the condition of the EXCITER FAULT LED's. If the currently-selected exciter generates a fault, the switcher will check to make certain the alternate exciter does not also show a fault. If not, the alternate exciter is automatically selected.
- REMOTE CONTROL
  When ENABLE is selected, the exciter switcher can be controlled by remote control equipment. When LOCAL is selected, remote control is blocked.

NOTE

Exciter Switcher REMOTE CONTROL DISABLE is independent of and is not controlled by LOCAL on the System Control Panel.

3.6 Amplifier Control Panel

The amplifier control panel (Figure 3-4) provides overall local control of a the standard Sigma® CD Amplifier cabinet. An LED associated with each control will illuminate on selection.

The amplifier control panel provides meter indications of Transmitter VSWR, IPA power metering, and output power metering. LED's indicate normal amplifier operational status as well as fault status.

Pushbutton controls allow the amplifier to be isolated from control by the System Control Panel and operated locally for test or in an emergency.

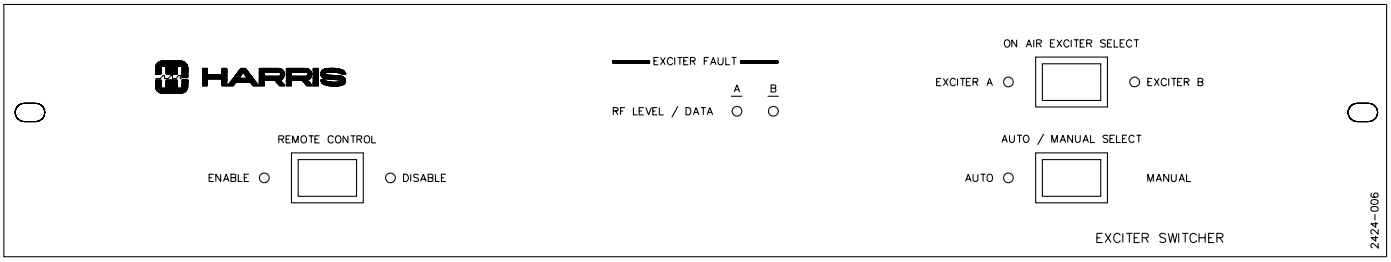


Figure 3-3.Exciter Switcher

WARNING: Disconnect primary power prior to servicing

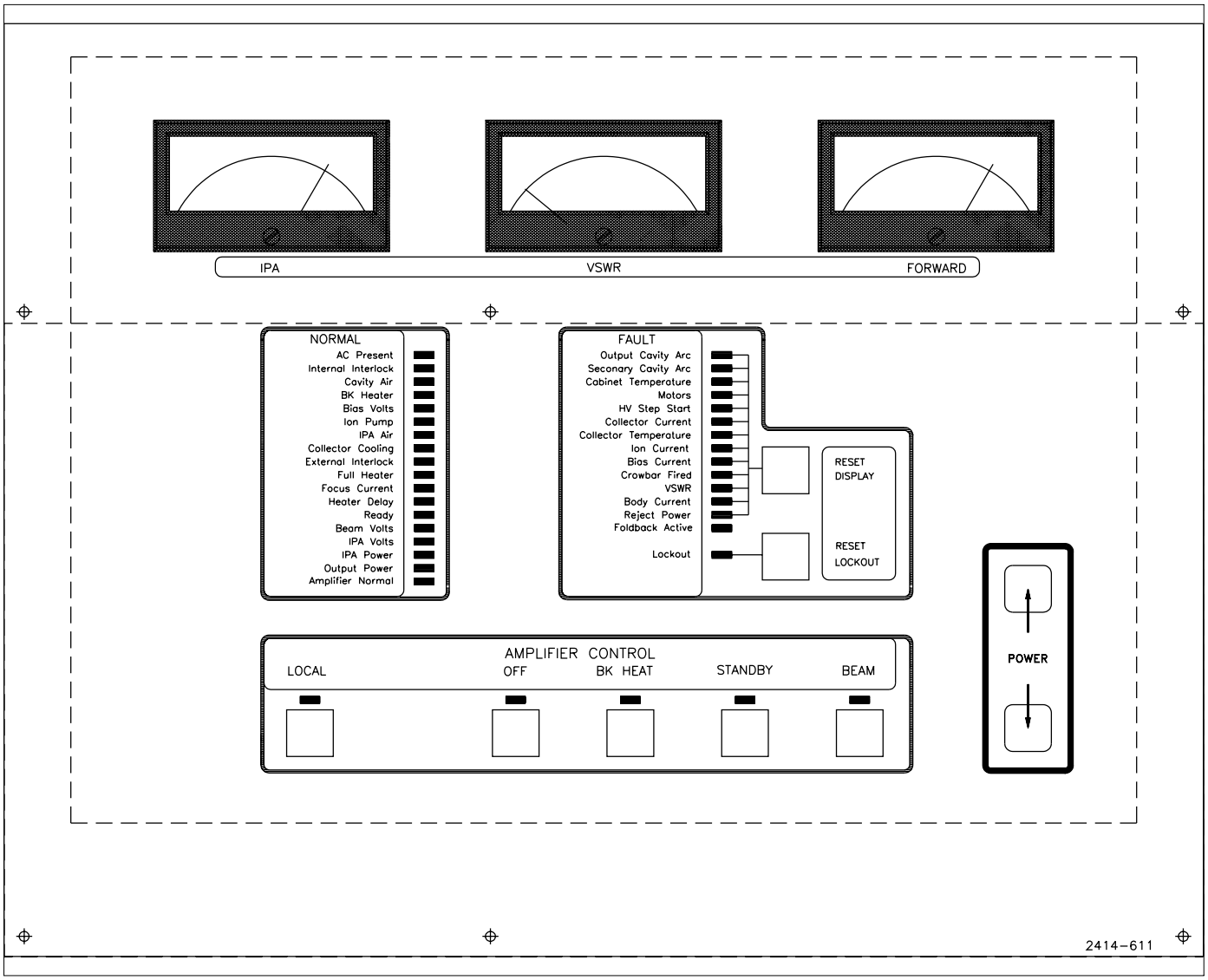


Figure 3-4. Amplifier Control Panel

3.6.1 Metering

Metering is provided for the following power functions.

- IPA
  — an indication of relative output power from the IPA.
- VSWR
  — a display of reflected power present at the output of the IOT in VSWR units. (Accurate only when the PA output is 100%)
- FORWARD
  — Indicates PA Output power

3.6.2 Amplifier Control

Amplifier control pushbuttons are provided for OFF, BK HEAT, STANDBY and BEAM. These controls are identical to those on the System Control Panel, but here they control only the PA in which they are located.

Pressing LOCAL interrupts PA cabinet control from the System Control Panel. The LOCAL LED indicates when the cabinet is in LOCAL mode.

This control can be used to isolate the amplifier from the System Control Panel for maintenance purposes.

Two additional pushbuttons, RESET DISPLAY and RESET LOCKOUT, are described in 3.6.5.

NOTE

OFF, BK HEAT, STANDBY, BEAM and the RESET LOCKOUT button are active only when the Amplifier Control Panel is switched to LOCAL. Thus, LOCAL must be selected in order to reset a lockout condition in the cabinet.

POWER raise and lower push buttons to the right side of the panel are not used in the Sigma® CD transmitter. Power control is on the System Control Panel. The POWER buttons on the Amplifier Control Panel can be connected to adjust the power output of the single PA cabinet if no control cabinet is used.

WARNING: Disconnect primary power prior to servicing

3.6.3 Amplifier NORMAL Status

NORMAL Status Indicators are Green LEDs, illuminated to show operation within the normal range.

- AC Present
  3 phase mains supply is within 15% of nominal and phase sequence has been detected as correct.

- Internal Interlock
  The PA cabinet internal interlocks and main ground interlock indicate proper connection.

- Cavity Air
  Cavity air pressure is present.

- BK Heater
  Reduced heaters are detected on the IOT and full heaters are applied to the thyratron.

- Bias Volts
  Bias voltage is present

- Ion Pump
  Ion Pump voltage is present and ION pump current is lower than 20 mA.

- IPA Air
  IPA air pressure has been detected.

- Collector Cooling
  IOT water flow detected.
  (IOT collector air flow in air-cooled units.)

- External Interlock
  Interlock is completed allowing the transmitter to operate.

- Full Heaters
  Full heater voltage has been detected on the IOT and the Thyratron.

- Focus Current
  Focus current is present.

- Heater Delay
  Heaters have been detected and:
  1. Standby has been selected for 5 minutes, or
  2. BK Heat has been selected for 30 minutes.

- IPA Volts
  IPA power supply voltage is present on both IPA supplies.

- Ready
  Amplifier is ready for beam to be applied. This LED will not light until all of the green NORMAL status lights above are illuminated.

The following green NORMAL indicators do NOT affect the Ready LED:

- Beam Volts
  Beam voltage has been detected. If not present shortly after BEAM is pressed, drive mutes and shunt trip operates, opening beam contactor.

- IPA Power
  IPA RF output is detected at greater than the minimum threshold, usually set to 20% of normal.

- Output Power
  Transmitter output is greater than 80% of the normal output level.

- Amplifier Normal
  All PA cabinet circuit breakers are set ON.

NOTE

The PA cabinet circuit breakers are located on a panel mounted at the lower left front of the PA cabinet, below the UHF Linearizer.

3.6.4 Amplifier FAULT Status

FAULT Status Indicators are Red LEDs, indicating a defect or improper operation. As a maintenance aid, these indicators remain illuminated until reset using the RESET DISPLAY button. The action triggered in the PA Cabinet by the fault depends on the type of fault.

All of the displayed faults except Foldback Active and Ion Current result in interrupting the transmitter's output. Faults which can cause immediate damage trigger Lockout, turning off the PA until reset. Some faults interrupt the output briefly, then restore operation, triggering Lockout if there are three occurrences within 30 seconds. The faults are noted as "3-shot" or "1-shot" below to show the type of action.

- Output cavity Arc [3 shot]
  An arc has been detected in the primary cavity.

- Secondary Cavity Arc [3 shot]
  An arc has been detected in the secondary cavity.

- Cabinet Temperature [1 shot]
  Cabinet over temperature thermostat has been tripped. Cabinet temperature has exceeded 70 Degrees C.

- Motors [1 shot]
  The motor thermal overload has tripped because of excessive motor current.

- HV Step Start [1 shot]
  After BEAM command, beam step-start did not complete. Triggers Lockout and trips the Shunt Trip circuit breaker.

- Collector Current [3 shot]
  Collector current higher than preset limit has been detected. Usually set between 2.5 and 3 Amperes.

- Collector Temperature [1 shot]
  Collector outlet water or air temperature is excessive. This sensor is usually set to trip at 70 degrees C.

- Ion Current [Not Used]

WARNING: Disconnect primary power prior to servicing

- Bias Current [1 shot]
  Bias current higher than preset limit (80 mA for EEV, 120 mA for CPI).

- Crowbar Fired [3 shot]
  The IOT crowbar protective circuit circuit has shunted the beam supply and interrupted the beam power.

- VSWR [3 shot]
  Reflected output power exceeded the trip level.

- Body Current [3 shot]
  Body current has exceeded its preset limit.
  —Nominal setting for EEV tubes is 50 mA.
  —Not used with CPI tubes.

The last fault indicator, Foldback Active, indicates VSWR has risen higher than 1.3:1, causing the logic to automatically reduce the PA's output power to a safe level.

3.6.5 Lockout Reset & Indicator Reset

Several PA cabinet faults are able to trigger the Lockout condition after 3 occurrences within 30 seconds. Lockout disables the PA's output until reset and switches the PA cabinet to OFF.

- RESET LOCKOUT
  Clears the LOCKOUT latch. The PA can then be turned back on. Reset Lockout does not clear the Fault LED's..

NOTE

RESET LOCKOUT can only be used when LOCAL is selected.

- RESET DISPLAY
  Used to reset the Fault LED's. The indicators remain illuminated until manually reset using this push-button, as a guide to maintenance personnel.

3.7 PA Tube and Driver Metering

Metering of IOT voltages and currents and of the Feed Forward Amplifier and the UHF Linearizer are provided by a switchable meter on the lower front panel of the UHF Linearizer (see Figure 3-5 below) and by an isolated meter panel above and behind the IOT in the PA cabinet. The location of the isolated meter panel may be seen in Figure 3-1.

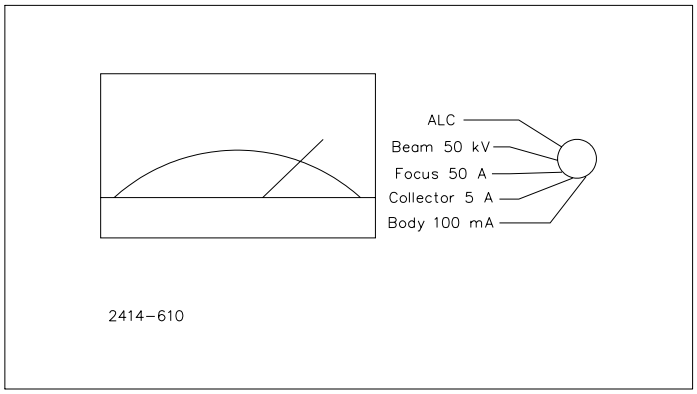


Figure 3-5. UHF Linearizer Meter Panel

3.7.1 Linearizer Meter Panel

The Linearizer front panel meter allows metering of:

- ALC
  The Automatic Level Control voltage from the Linearizer.
- Beam 50KV
  The Beam supply output voltage.
- Focus 50A
  The IOT focus current.
- Collector 5A
  The IOT Collector Current.
- Body 100 mA
  IOT body current (EEV tubes only)

3.7.2 Isolated Meter Panel

The isolated meter panel (Figure 3-6) is located inside the PA cabinet, above and behind the IOT carriage assembly. The panel contains the meters for voltages and currents in parts of the tube circuits which are at beam voltage potential. The meters are:

Bias	150V
Heater	10V
Bias	-100mA/+100mA
ION Pump	50uA

NOTE

Current CPI tubes also require that IOT heater current be monitored. In transmitters currently shipped for use with CPI tubes, a fifth meter is added to the isolated meter panel to provide this reading.

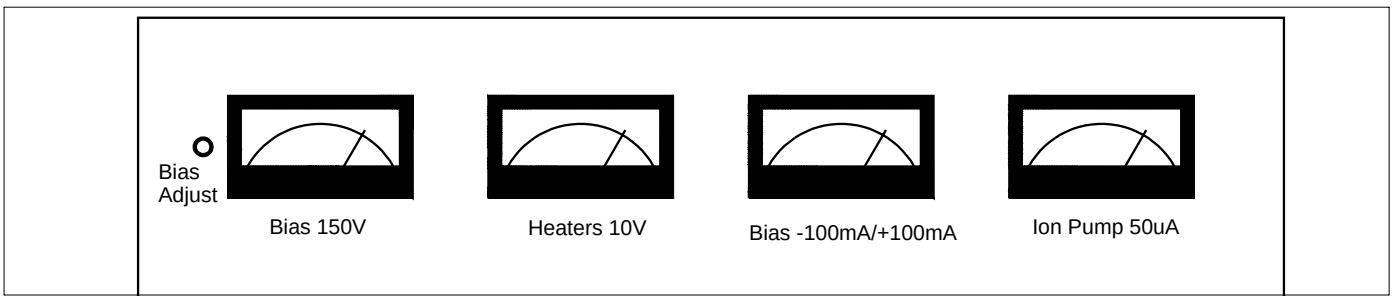


Figure 3-6. Isolated Meter Panel

WARNING: Disconnect primary power prior to servicing

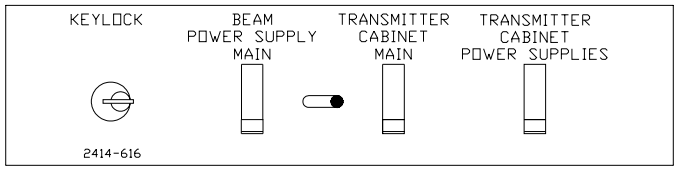


Figure 3-7 Line Control Mains Disconnects

3.8 Line Control Cabinet

The Line Control Cabinet is the main power control panel for the PA cabinet. Multiple-PA transmitters will have one Line Control Cabinet installed for each PA.

On the front panel of the Line Control cabinet are mains disconnects for:

- BEAM POWER SUPPLY MAIN
  - a control switch which can be used to interrupt the beam power supply primary power. Do NOT operate this switch when beam supply is ON!

- TRANSMITTER CABINET MAIN
  - a circuit breaker which controls the mains power to the PA cabinet, including the 3-phase blower.

- TRANSMITTER CABINET POWER SUPPLIES
  - a circuit breaker which controls mains power to the PA cabinet, not including the 3-phase blower.

In the top right-hand area of the panel are four LED indicators which can be used to check on the operating state of the Line Control cabinet.

- COMMAND SIGNAL PRESENT
  - The BEAM command from the PA cabinet has called for the beam supply to turn on.
- THERMAL INTERLOCK NORMAL
  - the thermal interlocks in the line control cabinet are all closed, permitting the beam supply to be turned on.
- STEP-START COMPLETE
  - The step-start sequence has completed successfully, applying power to the beam supply.
- BEAM SUPPLY BREAKER TRIPPED
  - The Beam Supply circuit breaker inside the Line Control Cabinet has tripped. Power has been removed from the beam supply.

3.8.1 BEAM SUPPLY BREAKER RESET

This push-button, located directly below the BEAM SUPPLY BREAKER TRIPPED light, may be used to reset the beam supply (shunt trip) breaker when tripped.

The Shunt Trip breaker, Q1, in the Line Control Cabinet, interrupts the mains leads to the beam power supply. The breaker may be tripped by an overcurrent or by auxiliary trip contacts, and may be reset by an electric motor operator.

When the crowbar fires to protect the IOT tube, the Line Control Cabinet contactors open but the Shunt trip may also be triggered. In this event, the crowbar circuit immediately resets the shunt trip breaker.

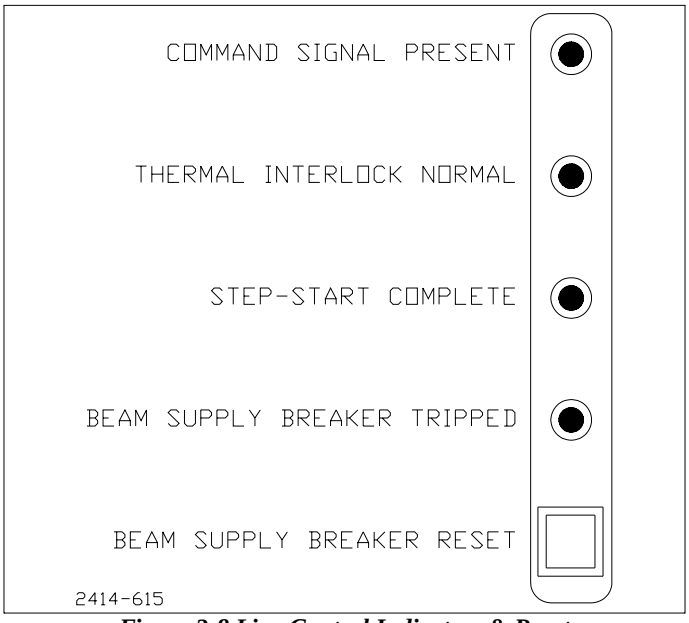


Figure 3-8 Line Control Indicators & Reset

HV Step Start failure, a fault displayed on the Amplifier Control Panel, also triggers the Shunt Trip to protect the equipment against overheating and possible fire.

WARNING

In the event of HV Step Start Failure, trace and correct the problem first, before attempting to reset the shunt trip. When the problem has been corrected, reset the Shunt Trip breaker using the Beam Supply Breaker Reset button on the Line Control Cabinet.
DO NOT operate the Beam Supply Breaker Reset button when Step Start Complete light is illuminated, as this will bypass the step start and cause excessive inrush and possible damage to equipment.

3.9 Cooling System

The liquid cooling system is controlled by the PA cabinet controller but most of the cooling system is outside the PA cabinet.

3.9.1 Flow Guages

Two inline flow guages in each PA cabinet display coolant flow rates for the IOT tube and the magnet assembly. The guages also include the coolant flow interlock switches.

These flow rates can be checked by opening the front door on the right side of the PA cabinet. The flow guages are on the right inside wall of the PA cabinet, mounted above the IOT carriage assembly.

WARNING: Disconnect primary power prior to servicing

3.9.2 Pump Module

Gauges on the control panel of the pump module (Figure 3-8) show the temperature and pressure of the coolant liquid at the outlet of the operating pump.

Status Indicators on the panel below the gauges signal the following:

- COOLANT LEVEL LOW
  - a warning that coolant level is approaching critical level and shutdown may occur.
- COOLANT TANK EMPTY
  - the transmitter will have shut down if this light appears.
- ALTERNATE PUMP MODE
  - indicates the Alternate Pump remote terminal has been used to switch from the pump selected by the LOCAL PUMP SWITCH to the alternate pump.
- AC POWER PRESENT
  - confirms AC power is reaching the pump module and that the level and the phase of all three phases are correct.
- CONTROL VOLTAGE PRESENT
  - confirms the presence of 12V dc control voltage.
- PUMP A ON / PUMP B ON
  - indicates which pump is currently running.

The LOCAL PUMP SWITCH located below the LED indicators can be used to select Pump A or Pump B as the operating pump.

Selecting this switch to the center-OFF position turns off both pumps.

Note

A connection has been provided in the Pump Module to permit remote selection of the operating pump. Grounding the connection causes the alternate pump to be selected and the ALTERNATE PUMP MODE light to light. The LOCAL PUMP SWITCH on the pump module must be in the PUMP A or the PUMP B position in order to use this feature.

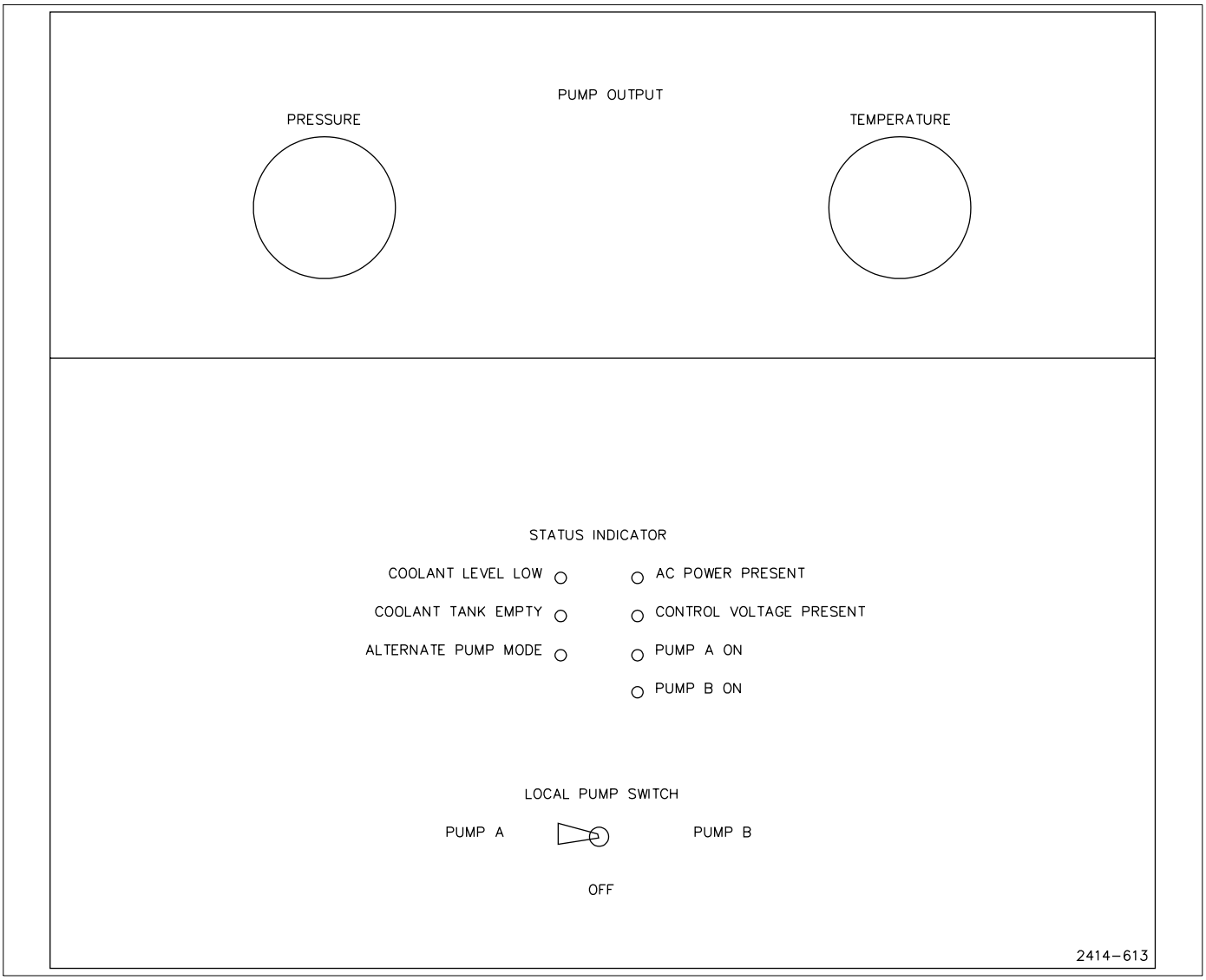


Figure 3-9 Pump Module Control Panel

WARNING: Disconnect primary power prior to servicing

WARNING: Disconnect primary power prior to servicing

4.1 Control Cabinet

Each transmitter is provided with a Control Cabinet. The Cabinet is capable of controlling up to 4 Amplifier Cabinets, two **CD 1™ Exciters**, Exciter Switcher units, output RF system, power control, system power metering and interlock interface.

In addition to system control the unit provides fault monitoring of system parameters. The subsystems will be discussed as individual assemblies.

4.1.1 System Control PCB

Refer to schematic dwgs:

839 8121 168 IOT Control System Overview

839-8121-798 System Control Panel

The System Control PCB comprises the following circuits: Control Inputs, Meter Selection, Amplifier Status, System Status, Power Control and Control Latch.

4.1.1.1 Power Supplies

The PSU inputs from the control cabinet wire harness are supplied via X1 for the +5V, +12V, -12V bus with LEDs H46, H47, H48 indicating presence of the supplies respectively. The supplies are derived from the Control Cabinet logic PSU's via the fuse distribution PCB.

4.1.1.2 Remote Controls

The seven remote system controls, Off, BK Heat, Standby, Beam, Power Raise/Lower, and System Fault Reset commands generate ground contact closures which are input via X6 to Schmidt Trigger A2. A2 then routes the trigger output to OR gate A17 where the remote command inputs are OR'ed with the Local front panel command inputs from AND gate A19 if enabled.

Or gate A17 then applies the command input (Local/Remote) to A3, a quad 2-input multiplexer. A3 then outputs the selected 4 bits of data from the two sources to the line driver A41 (sht7). A41 in turn drives the command outputs via X5 to the System Interface Panel and on to the individual amplifier cabinet sytem remote inputs.

4.1.1.3 Local Controls

Refer to schematic 839 8121 798 (Sht. 2), System Control Panel

System local controls for Off, BK Heat, Standby, Beam are initiated by a front panel contact closure to ground and routed via Schmidt trigger A1 to LOCAL/REMOTE selection AND gate A19. DIP Switch S8 position 4 is closed to prevent parallel operation of local/remote control inputs in remote operation. This applies a logic 0 to AND gate A19 to disable parallel operation.

The Power raise lower commands are initiated via contact closure to ground which is in turn routed to Schmidt trigger A34 for input into the system power circuitry detailed on (Sht 5). Local/Remote selection is accomplished through a front panel contact closure to VCC which is routed via retriggerable monostable A45A in the Local/Remote Latch circuitry detailed on Sht 7.

4.1.1.4 Control Actions

The selected command function is applied to OR gate A17 which passes either local or remote commands on to the Quad 2-input Multiplexers A3, A4. A3 outputs are routed to the control driver circuitry A41 (detailed on Sht. 7), while the A4/4 output(RESET I44) is routed via X5 to the System interface PCB and eventually on to the individual amplifiers via system control interconnects.

The command output generated by A3 drives inverting octal buffer A41. The command selection loads A41 which in turn provide amplifier commands to individual cabinets via X5 to the System Interface PCB.

The LOC/REM signal applies a momentary logic 1 to retriggerable monostable A45A. The Q output in turn drives And gate A9A, and Nor gate A12c which apply ground to energize relay K1. Contacts 11 and 9 of K1 provides a ground to Schmidt trigger A33F. It's output in turn sets to a logic 1 when local is selected generating the signal (LOC/REM 1). The input to A33F is also wire Or'ed to generate a logic 0 for the signal (A/B SELECT 1). The signal (LOC/REM 1) is then routed to power control circuitry (detailed on Shts. 5 and 6), and the Status Remote LEDs while the (A/B Select 1) is used to select A or B inputs to the Quad 2-input multiplexers A3, A4 and A31.

4.1.1.5 Status Readback

Refer to schematic dwg 839 8121 798 Sht. 1

The System Control Panel Status LEDs are derived from the OR'ed status readbacks from the amplifier cabinets I25-28, and System summary fault indications I29-42. The OR'ed amplifier status' are input to Schmit trigger A33. A33 drives LED driver A16 which illuminates the associated amplifier status LED.

NAND gate A6 monitors Amplifier 1-4 Normal signals as well as the external systems normal signal from A33E. When all inputs are Normal A6 outputs a logic 0 to NOR gate A12A. A Loc/Rem signal is also monitored. A12A has it's output wire Or'ed with the Systems Normal Status (I30) to illuminate the System Normal LED via LED flash NOR gate A11A and LED driver A16.

If any amplifier, external system or remote control switch is not normal the System Normal LED will flash at a 1 Hz rate due to the Or'ing of the 14 stage binary ripple counter A13 with the system normal signal at A11.

Summary alarm status indications are input to the system board connector X5 via the System Interface PCB, Exciter/Exciter Switcher and Mode Controller. These alarms will be addressed individually.

The Exciter, Power Normal, System VSWR, and Reject Load summary fault inputs I31-38 are applied to line driver A15 to, in turn, illuminate the appropriate system fault LED.

WARNING: Disconnect primary power prior to servicing.

External systems normal (Mode Controller in Remote, Exciter change- over in Auto/Remote) and individual amplifier local/remote indications are applied to NAND gate A6. X21 programs the presence of an amplifier for system normal gating. A6 in turn drives NOR gate A12A which compares Amp Normal signals with the system remote normal to generate an output to NOR gate A11A. The 1 Hz input from oscillator A13 then fires A11A until all Amplifier Normal, System Normal and Remote indications are satisfied. When this occurs A11A outputs a logic 1 which drives line driver A16/8 and illuminates the System Normal LED.

4.1.1.6 Meter Selection

Refer to schematic dwg 839 8121 798 Sht. 1,4

The analogue meter voltages are routed to the System Control PCB from the System Interface PCB via 16 way IDC connector X4. The Reject meter selection is accomplished via a front panel contact closure switch to ground. This fires Schmidt trigger A2F which in turn increments the up command of the 4 bit binary Up/Down counter A25. The binary output of A25 in conjunction with DIP switch S12 drive 3-8 line decoder A14. The decoder output selects the appropriate meter/LED outputs of A28 and A26 respectively.

Reject Load analogue metering voltages are routed to 8 channel analogue multiplexer A28. The output drives Op Amp A30D, to provide a switch selectable meter to indicate Reject Load 1-3 power. The alternate Op Amp A30C drives a terminal block in the rear of the control cabinet. This allows use of a multimeter to facilitate phasing adjustment to minimize reject load power.

The Forward Power and VSWR metering circuits are identical. The Forward power metering only will be discussed. The System Interface PCB detects a DC voltage relative to power. It outputs this voltage to the System Control PCB via X4. The Forward voltage is then routed to opamp A30A to drive the front Panel Metering circuit.

4.1.1.7 Amp Status

Refer to schematic dwg 839 8121 798 Sht. 1,3

Amplifier status readback are input via the System Interface PCB to X5. They are then routed to Sht. 3. The amplifier status' I1-16 are routed into LED drivers A23, A22. These in turn illuminate green amplifier status LEDs on the System Control Panel.

4.1.1.8 Power Control

Refer to schematic dwg 839 8121 798 Sht. 1,2,5,6

Forward Power raise command only will be discussed for simplicity. Power control commands are selected via the front panel Raise switch. This applies a contact closure to ground which fires Schmidt trigger A34D (Sht 5). A34D outputs a logic 1 to OR gate A32B which generates a COUNT VISUAL LOCAL signal.

NOR gate A12B in turn generates a logic 0 which causes FET V5 to energize the Local 2 Speed Control circuitry consisting of A34, A9, A11. A9 also has a CLOCK 1 and CLOCK 2 input from A13.

This in turn generates the CLOCK 3 output to drive the power control output (detailed on sht 6). AND gate A18, NOR gate A20, OR gate A27D generate a COUNT signal and determine whether the count is going up or down. Quad 2-input multiplexer A31 then selects the appropriate data path information to drive the digital pot as detailed on Sht. 6.

4.1.1.9 Digital Pot

Refer to schematic dwg 839 8121 126 Sht. 6

The Digital Pot receives the Count, U/D signal to increase or decrease the output voltage which in turn will be used to drive the amplifier cabinet AGC and UHF Linearizer power control pot input. Voltage regulator A39 provides a stable 5V reference to AND gate A35. The Clock 3 and Count Visual inputs generate an output from A35 which drives digital pot A36 if it is enabled with a U/D Visual enable. The variable voltage output from A36 will be buffered by Op Amp A38 to drive the amplifier AGC and UHF Linearizer via the System Interface PCB and amplifier interconnection harness.

4.1.2 System Interface Panel

Refer to Schematic Dwg 839 8121 799 Sht. 1-5

The System Interface Panel comprises the following circuits: Amplifier Interface 1-4 (Sht. 2,3), Exciter Inputs (Sht. 4), Power Metering, VSWR and Reject Load Metering (Sht. 5).

The System Interface Panel provides a means to interconnect the transmitter at a system level. Control outputs from the system control panel are routed via the system interface to the individual amplifier cabinets. Exciter status, Power, VSWR, and Reject Load metering are routed through the System Interface Panel to the metering and status outputs of the System Control Panel to drive the front panel metering and status indicators. All system remote control status outputs are terminated on this assembly. Provisions are also made to receive external waveguide and system normal signal via X28. DC power is supplied via X2 from the Exciter PSU Distribution PCB.

4.1.2.1 Amplifier Interface 1-4

Refer to Schematic Dwg 839 8121 799 Sht. 1,2,3.

Amplifiers are connected to X16,17,20 and 21 via 15 pin multiconductor cables. For circuit description Amplifier 1 Interface will be discussed. The interconnect cable for amplifier 1 provides both system status and commands via X16. Status indications are routed to inverting line driver A15B to provide Amplifier 1 Normal, Ready 1, Vis/Comb Normal 1 and Lockout 1 (O5-20 signal lines) to the System Control Panel via X4. The command status read backs are processed via inverting line Drivers A24A and A16 where the output signals O1-4 (Off 2, BK Heat 2, Standby 2, Beam 2) are wire OR'ed together. These signal are then routed to the System Control PCB via X4 for system status monitoring. Inverting line driver A27B, A2 and A1 in turn drive the System Remote Control status outputs. System commands are initiated on the System Control PCB and then routed to the System Interface PCB via X4 and on to inverting line drivers A5, A28. The command outputs of A5, A28 (signals I6-16) are then applied to the individual amplifier cabinets via A14 and A22 to control the amplifier cabinets.

4.1.2.2 Exciter/External Inputs

Refer to Schematic Dwg 839 8121 799 Sht. 4

WARNING: Disconnect primary power prior to servicing.

Exciter status inputs are routed from the associated Exciter/exciter switcher unit via control cabinet cable harness to X22 of the system interface PCB. A closure to ground indicates a fault condition has occurred in the exciter. Inverting line driver A27A drives OR gate A30 to generate a logic 1 output. The output in turn will be routed to the System Controller status indicator circuitry to generate an Exciter Fault LED indication. External Normal and Waveguide Controller inputs are routed into the System Interface PCB via X28 to NOR gate A23A/B/C. A logic 1 will be generated if any External System Normal condition is not made. This in turn will drive the status readback circuitry to extinguish the System Normal LED.

4.1.2.3 Forward, VSWR, and Reject Power metering

Refer to Schematic Dwg 839 8121 799 Sht. 5

The System Interface PCB is interconnected to the RF system Forward power, Output VSWR and Reject Load directional couplers via RG 223 or RG 58. These connect via X9-13 BNC Bulkhead jacks. A signal input of 100MW is used to calibrate a full scale meter deflection. All metering is accomplished in a similar manner. Reflected input will be discussed as an example of circuit operation. Incoming RF arrives on board through X13, a BNC coaxial socket, and is fed to diode detector V15. The demodulated signal is then buffered in A10B before being applied to a peak detector consisting of V20 and A10C. Meter calibration is performed by R96, R148 and A10A, which drives the front panel VSWR meter and the Remote Control analogue VSWR output. A separate output is routed to a level detector consisting of R97 and A10D to a Reflected Power trip indication for remote control/system status fault indications.

4.2 Mode Controller General Description

Refer to Schematics 839-8121-169, 839-8121-161.

The Mode Controller PCB and its Local Control Panel provide programmable command/ status interface between the RF System and Transmitter system. Local or remote commands can be issued to change system configuration between combined amplifier operation/single ended modes, antenna or test load termination and diplexed/multiplex drive configuration. During operation of the waveguide output switch from Antenna to Test Load the Mode Controller will also issue Standby commands, monitor amplifier status change and re-apply Beam command once the switch has reach its appropriate end stop.

(Refer to schematic 839 8121 169 Mode Controller Functional Overview)

A contact closure is initiated by depressing the desired Local Control Panel Mode Switch. This is routed by a 26-way ribbon cable to the Mode Controller Local/Remote selector latch. The selector latch outputs the selected command to the Set Antenna Switch And Gate, the programmable decode waveguide/multiplex control outputs, the programmable decode line stretcher control outputs and a selection status comparator. The command output from the mode controller will then energize the associated RF system function. Once the RF system completes the command function it will generate a status readback to illuminate the selected Local Control Panel LED indicator and the system will be in the selected operational mode.

4.2.1 Mode Controller Detailed Circuit Description

NOTE:

Mode Controller is not utilized in a single amplifier configuration

(Refer to Schematic dwg's 839 8121 161 Sht. 1-6 Mode Controller and Table 2-32)

4.2.1.1 Mode Controller Power Supply

Mode Controller power is derived from the Control Cabinet's Exciter PSU Distribution PCB. The mode controller may utilize either single or dual PSUs. X3, X4 route the +5V, +24V, and 0V to the appropriate monitoring LEDs and fused supply bus. H2, H3 indicate the 5V PSU is present while H1, H4 indicate the presence of the 24V PSU. V2, V3, V5, V6 provide isolation between the mode controller and the external PSUs. Decoupling and transient protection are provided by C18, C19, V1 for the +5V bus and C21, C20, V4 on the +24V bus. A separate 12V PSU located physically below the Mode Controller is used for the relay contact closure commands to the associated RF System via a multicore cable (see amplifier interconnect drawings).

4.2.1.2 Control Actions

Depressing the MODE 1 push button generates a contact closure to ground which is routed from the Local Control Panel X1 (dwg 839 8121 162) to the Mode Controller X5 via 26-way ribbon cable. The input is routed into the filtered input of Schmitt Trigger A1, the output is then applied to AND Gates A5, A6, A7. The alternate input to these gates are provided from link X2 which selects either a ground or VCC. Selection of position a-b (ground) prevents local controls from operating in parallel with remote control inputs. The outputs of the A5, A6, A7, as well as the opto-isolated remote control inputs A3, A4, A24 are routed to the OR gates A8, A9, A10. The OR gates in turn drive the quad 2-input multiplexers A14, A13, A12. These devices select which input commands are utilized, local or remote.

The selection of Local/Remote command is controlled by Schmitt trigger A2, A19, .1 second retriggerable monostable A11, And gate A18, relay driver A20 and DPCO latching relay K1. This effectively forms a debounced latching relay whose output drives the A/B select input of the quad 2- input multiplexers A14, A13, A12.

The selected quad 2-input multiplexer (A14, A13, A12) output is then routed to A15 Decimal to BCD encoder, and A16 gate. During a command selection two events occur. First the BCD output of A15 is applied to a 3-8 line decoder A17 which in turn drives an Octal D type transparent latch A22. Second the command output of AND gate A16 drives the 10.34 second retriggerable monostable which in turn triggers the G2 input of A17 and the OE input of A22. This prevents multiple mode selections during the 10.34 second window. The enabled mode set command output of A22 is then applied to line driver A23 which supplies the selected Set command to the control outputs and

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local display gating as detailed on Sht. 2 of dwg 839 8121 161. The Antenna/Load command input is processed in a similar manner using A2, A7, A21, A23, A20 to generate the following signals, Set Ant, Set Load, Set Ant 1, and Set Load 1. Again these signals are routed to Sht. 2 of dwg 839 8121 161.

4.2.1.3 Drive and Tally Select

Refer to Sht. 2 of dwg. 839 8121 161

The Set 1-7 and Set Ant/Load command inputs are routed to Local Display Gating circuit comprised of Schmitt triggers A19, A27, AND gates A18, A31, A32 , NOR gates A33, A35 and into Line driver A34. This circuit compares the Waveguide/Output Switch System Status opto-isolated inputs (Tally 1-9) with the command state and in turn drives the Local Control Panel LEDs. 14 Stage Binary Ripple Counter A28 generates a 60 hertz oscillator output. Link X8 routes either the clock output, ground, or VCC to the Local display gates A18, A31, A32. This allows programming of the display gate to indicate the following:

a. X8 a-b Solid LED if Status=Selection, Flashing if Status Selection.
b. X8 b-c Solid LED from status + temporary LED from selection.
c. X8 b-e Solid LED indicating only when selection is made.

4.2.1.4 Control Outputs

Refer to Sht. 2,4 of dwg. 839 8121 161 and Table 2-32

The Set 1 input signal, (Mode 1 Local Control Panel Selection), is routed to Control Outputs detailed on Sht. 4 as a CON 1 command. Programmable Mode Control Output DIP switches S10-S18 select appropriate relay drives to the RF System. In this instance assume usage of the HD80 system configuration. CON 1 line pulls low (logic 0). We need to energize two relays to generate contact closure commands for PSH1 Pos1 and PSH2 Pos1 command outputs. The system interconnect shows us that these commands are derived from contact closures from K2 and K3 respectively. For the CON 1 signal to energize these relays, S10 pole 1 and S11 pole 1 must be in the On position. This allows the Con 1 command (logic 0) to be read through NAND gates A49, A50 to the line driver A64 input. A64 inverts the logic 1 and energizes K2 and K3 which generate a contact closure to energize the RF System Phase shifter motors. When the phase shifters reach the end stop in position 1 a status read back from a limit switch is returned to the mode controller Status I/P Matrix.

4.2.1.5 Status I/P Matrix

Refer to Sht. 2,3 of dwg 839 8121 161, and Table 2-32

The Waveguide System /Output Switch Status inputs are fed into the Mode Controller via opto-isolators A24, A25, A26. The status signals are then routed as SW1-11 signals into the Status/Tally Decode Logic. The decode logic can be programmed by DIP Switches S-2 through S-9 to allow multiple amplifier system specific setup ie: RF PSH 1 and 2 are in position one. The status readbacks would be routed via the interconnect cable to the Mode Controller status inputs. In this case signals SW1 and SW2 pull low. To illuminate Mode 1 LED (V1+V2), Tally 1, which is used to generate Mode 1 status would need to go to a logic 1. Dip Switch S3 would be programmed with G/H in the closed (1) position ABCDEF would be in the (0) open position which ties the VCC pullup resistors (R57, R58) to the input inverting Schmitt triggers A27,A36, A39, A46. This would allow the SW1/SW2 inputs to be transferred into A41 NAND gate which would output a logic 0 to Tally-1 and A39C inverting Schmitt trigger would output a logic 1 on the Tally 1 output. This would then provide A42 line driver with a logic 0 out to the Mode 1 O/P line for remote status. The Tally 1 would also be compared with the Set 1 command via the Local Display gate to illuminate the Mode 1 LED (V1+V2) on the Local Control Panel.

4.2.1.6 Line Stretch Switch

Refer to Sht. 5 of dwg. 839 8121 161 and Table 2-34

To allow proper power combining of multiple tube transmitters the Mode Controller must be capable of switching in preset phasing line stretchers. This is accomplished with the Line Stretcher decode circuit. The TAL1-8 lines go to a logic 0 for each known mode. Programmable DIP switches S21, S22 are set to energize K15 and K16 respectively based on the DIP information. In a 3 amplifier configuration TAL3 (V1+V2) would pull low. S21 pos 3 is closed (1) which would apply a low to NAND gate A67. Its output would go to a logic 1 and relay driver A65F output would pull low energizing K15 which in turn would energize a coaxial switching relay in the base of the Control Cabinet to allow proper driver phasing for the amplifiers selected to air. If TAL4 (V2+V3) would pull low S22 pos 4 is closed (1) the low from TAL4 would input to NAND gate A66 which in turn would output a logic 1. Relay driver A65G would invert this level and energize K16 which in turn energizes the associated coaxial switching relay in the base of the Control Cabinet to allow proper driver phasing for the amplifiers selected to air.

4.2.1.7 Multiplex Mode Decode

Refer to Sht.4 of dwg. 839 8121 161

The multiplex decoder relies on the TALLY1-8 signals to again energize a latching relay via programming DIP Switches S19, S20 as previously demonstrated. When the appropriate switches are selected the DPCO Latching relay K11 latches in either the Normal or Multiplex mode.

4.2.1.8 Set O/P Switch

Refer to Sht. 6 of dwg. 839 8121 161

The Set Ant2/ Set Load2 commands are derived from Sht. 1 then routed to Sht. 2 and Sht. 3. A logic 1 is input to OR gate A10C, it in turn outputs a 1 into AND gates A60C, A69C. Next establish a normal interlock condition via X15/5,6. This input is a logic 0 and is routed to A68B inverting Schmitt trigger. The output from A68B is now a logic 1. The transmitter is also in the Beam on condition therefore a logic 0 input to inverting Schmitt trigger A68A produces a logic 1 out. These two levels serve to fire the AND gates A69A, A69B, allowing A69C to fire 11 sec Force Standby Timer and set all amplifiers to Standby. They also provide enables to AND gates A60A, A60B which in turn allow a Set Ant2/ Set Load2 command to energize the appropriate command relay K13, K14. Once the force standby timer returns low the Beams on all amplifier cabinets return to normal. The 9 second selection latch timer detects a change in command state (Ant/Load). This generates a SWSET to A63A trigger input. The

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/Q output is then routed back to via the SWLATCH line to the Octal Latch A21. This prevents multiple commands from being generated in the 9 second window.

4.3 Exciter Switcher Assembly

Refer to Technical Manual 988-2426-001

4.4 Amplifier Control

The amplifier is designed primarily for unattended operation under automatic or remote control.

The Control and Status Panel Assembly, which uses CMOS logic and LED indicators controls the start/stop sequences and maintains a continuous surveillance over the operation of the equipment.

A push button selects LOCAL or REMOTE with the operating state indicated by a green LED. Switching between Local/Remote does not interrupt the transmitter's operation. When LOCAL is selected the operational state is determined by five push buttons.

Provided that the three phases of the supply are present and all interlocks are made LEDs indicating these will be illuminated at all times. The transmitter can be returned to this lowest operational state by pressing the OFF button.

When BK HEAT is selected, either locally or remotely, the LED above the button will illuminate, a green LED lights when the cooling air is NORMAL followed by green LEDs for Heater, Bias Volts, and Ion Pump Normal. After a delay has elapsed the green Heater Delay LED will light.

When STANDBY is selected from OFF the above Background Heat sequence is initiated followed by Collector Cooling Normal, Focus Current Normal and Ready. At this stage heaters are on full and the transmitter is ready for instant operation.

When selecting BEAM an identical sequence up to the Standby state is reached. The green Beam Volts LED lights after the high voltage is applied in two stages and proved. This is followed by two other LEDs which indicate that the intermediate amplifier and output powers are within limits.

If the STANDBY or BEAM buttons are pressed the transmitter proceeds automatically to the state selected without the need to operate intermediate controls.

A Reset command will reset any alarm conditions.

4.4.1 FAULT Indications

Green LEDs on the control and status panel assembly indicate normal conditions.

Red LEDs indicate all fault conditions.

Control buttons have LEDS (mounted above the buttons), which stay full is acknowledged.

An LED test facility is provided.

4.4.2 Fault protection

The logic will shut the transmitter down immediately if over current in the motor windings occurs; the water system fails; the collector temperature becomes excessive; or the high voltage supply second step contactor fails to close.

Connections within the logic may be preset so that the following conditions will individually either cause an immediate shutdown or actuate a 3 or 4 shot auto restore circuit, thereby preventing prolonged interruption due to transients.:

- overloads of the IOT collector or body current
- excessive forward or reflected output power
- arcing in the output cavities of the tube

Fault location is facilitated by red LEDs which light to indicate if any of these fault conditions have occurred. They remain lit after a shutdown or a successful restart until reset by the LED Reset button. A non-volatile memory retains fault indications in the absence of the mains supply.

If the transmitter has shut down due to a fault, other than a motor failure, a red Lockout LED will light until the logic is reset either by the Fault Reset button or remotely. If the Lock out is due to a motor failure, a red Motors Fault LED lights until reset locally. A motor lock out can not be reset remotely, the motor over current contactor must be manually reset.

4.4.3 Power metering

Power meters are provided for:

- Forward Power
- IPA Power
- VSWR

The Forward Power is measured by a coupler at the output of the IOT/Klystrode. It's output is routed to the Analogue & Digital Interface assembly which feeds a detector in the logic and in turn drives the front panel metering and Power Normal LEDs.

The IPA power is average power measured by a coupler at the input to the IOT which feeds a detector in the logic.

VSWR is scaled from average power measured by a reverse directional coupler immediately at the output of the IOT, which feeds a detector in the logic via a low pass filter. Placing this coupler as close to the tube output as possible gives maximum protection against a fault occurring at any subsequent point.

4.4.4 Remote control and monitoring

Facilities are provided to enable remote control and telemetry or data logging equipment to be connected.

When remote control is selected, commands given by the continuous or momentary closure of pairs of contacts may be used to duplicate the functions of the local control buttons from a remote point.

Remote control and monitoring is via standard "D" type connectors on each amplifier and the system control rack.

Remote status indications for normal and fault conditions are made available by the open collector method. In addition analogs

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of voltage, current and power levels are available and should be scaled to be less than 4 Volts.

Internal meters are provided to read:

- Beam volts
- Beam current
- Grid volts
- GIon current
- Heater volts
- Body current

4.5 Line Control Cabinet

NOTE

It is recommended that the Line Control Cabinet derive it primary power via 200 amp fused disconnect. This will eliminate possibility of a nuisance breaker trip due to inrush current during crowbar events.

Mains power distribution is the primary function of the Line Control Cabinet. Three phase power to the beam power supply, transmitter cabinet power supplies, and transmitter cabinet fans and blowers is distributed and controlled in the cabinet.

The 480 Volt version of the line control cabinet is equipped with a transformer that provides power to all the 220 Volt, single phase circuits in the transmitter. The 380 Volt cabinet design utilizes the main power phase-to-neutral voltage to power the same circuits.

Circuit breakers provide protection for each branch output. The incoming power line is equipped with transient protection in the form of phase-to-phase and phase to ground metal oxide varistors.

Beam power supply high voltage overshoots and high surge currents are avoided using reliable and proven step-start techniques. The step start circuits are located in the Line Control Cabinet along with indicators that show successful completion of each step of the step-start sequence.

A fast release three phase vacuum contactor driven by a solid state relay effectively limits beam supply follow-on energy into a fired crowbar (used in the transmitter to protect the IOT). Both the vacuum contactor and the solid state relay are built into the Line Control Cabinet.

The transmitter logic and Line Control Cabinet are closely integrated: the logic provides 1st and 2nd step commands to the Line Control Cabinet, and the cabinet sends status of those commands back to the logic. Protection is provided by the logic. An error sensed in the status of the beam supply high voltage verses the status of the Line Control Cabinet results in the beam power supply circuit breaker being opened via a circuit breaker shunt trip mechanism.

4.5.1 Remote Shunt Trip Reset P.C.B.

This circuit provides a contact closure status of the BREAKER TRIPPED condition and a means of remotely resetting Q1 via the station's remote control system.

From the remote location, 2 attempts at resetting breaker Q1 are allowed before the circuit ignores any further attempt to reset. Thus, if 3 trips within 5 minutes do occur, a legitimate problem must exist an should be investigated at the transmitter site. Successful resetting of Q1 that lasts for at least 5 minutes without tripping again will reset the counter circuit that limits the number of reset attempts. Operation of the local reset cabinet also resets the counter.

The local reset button mounted on the line control cabinet is not restricted to only 2 resets, however BOTH remote and local reset functions will NOT operate if the cabinet BEAM ON function is still active; set the cabinet to STANDBY before attempting to reset the shunt trip. This assures that the beam power supply step-start function is not bypassed.

4.5.2 CIRCUIT DESCRIPTION

Refer to schematic 843-5466-771.

Control voltage is not applied to the circuit board until Q1 trips and it's auxiliary contacts energize K1 via TB1-10. +24 volts is then applied to regulator U1 which provides +12 volt power to the rest of the circuit. In this manner, the board remains immune to voltage spikes and other environmental disturbances in the line control cabinet. Also, a contact closure on K1 provides the remote status indication that Q1 has tripped off.

Once control voltage is present, activating the remote reset command via TB1-1 energizes K2 via U2, U4-2, U4-6, and Q2. The contacts on K2 activates the 120VAC Q1 reset relay in the line control cabinet. The reset command also triggers the 2-shot counter formed by U3. After the second reset attempt, pin U3-12 of the counter goes LOW preventing any further reset commands from clearing gate U4 by applying a LOW to U4-1.

Local reset is done via TB1-3. When U4-5 goes LOW, K2 is again energized. Note that this circuit path is not subject to the state of the 2-shot counter. The circuit IS inhibited if the beam on command to the line control cabinet is present and contactor K3 in the cabinet closes. Auxiliary K3 contacts supply +24V to TB1-7; the presence of this voltage inhibits reset from any location by forcing the gate of Q2 to remain LOW via U2-12, Q1, and CR8. Note also that operation of the counter is inhibited by holding data lines U3-5 and U3-9 low via CR13 and CR14.

Counter reset can be done 3 ways:

1. A local reset command forces U4-10 HIGH and resets U3 via pins U3-4 and U3-10.
2. After Q1 successfully resets, +12 volts is removed from the circuit except that the +12VB bus bleeds down very slowly. After approximately 5 minutes, the +12VB bus is sufficiently low that, if another trip occurs, a pulse is applied to the reset line via capacitor C6 as a result of the +12VB bus suddenly returning.
3. If solder jumper JP1 is changed to position 2—3, the counter will reset from either the local reset button, or from the action of applying and removing the cabinet BEAM ON command. Because an operator could repeatedly reset the shunt trip by this method even if a real

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problem existed, it is recommended that this jumper position NOT be used.

The reset command from the station remote system is connected to TB1-1&2; tripped status indication appears on TB1-5&6.

To minimize usage of the remote control channels, remote Q1 tripped status connections from each line control cabinet can be connected in parallel. This means that at the remote location, information that AT LEAST ONE line control cabinet shunt trip has operated.

Likewise, the remote reset command lines can be connected in parallel. Since each reset circuit card is activated only after Q1 trips off, the set command will only act on those line control cabinets whose Q1 breakers have tripped.

Personnel performing maintenance work in the transmitter cabinets may lock out the beam supply main and transmitter cabinet circuit breakers from being closed by using the lockout mechanism and key on the front of the Line Control Cabinet.

A floor mounted, wall supported enclosure using only 3 square feet of floor area houses the Line Control Cabinet. Access to each component is easy and straight forward, requiring only the removal of the handle-equipped front panel.

4.6 Unitized High Voltage Beam Power Supply

The transmitter's high voltage needs are provided by a unitized oil filled DC power supply. The supply is designed to withstand adverse weather and therefore may be mounted outside the transmitting building.

Oil immersion of critical components like high voltage transformers, rectifiers, and filter chokes provide superior dielectric strength and uniformity that helps prevent high voltage arcing and corona. The excellent heat transfer properties of the oil reduce the stress on the electrical components. As a result, power supply life is expected to exceed 20 years, even when sustained daytime ambient air temperature is 104 degrees Fahrenheit.

Access is easy; and there is no danger of tools falling to the bottom of the oil tank because tools aren't needed to remove the submersed components module. Rectifier stacks, transient suppression networks, and bleeder resistors are mounted on the module. They can be serviced on the workbench, once the components module is removed from the oil.

Attached to the oil tank, the junction box is where electrical connections to the power supply are made. Filter capacitors and primary transient components are mounted here. The junction box cover is held in place with several captive type bolt-clamps. A safety and convenience feature of the cover design allows it to remain in place, even if all the fasteners are removed. Foot injuries from a falling junction box cover are less likely. Handles on the cover aid in its removal and replacement.

Changing output voltage is straightforward. A tap switch handle mounted on the side of the oil tank selects up to 5 different output voltages. Access to the tap switch handle is prevented by a lockable hinged cover. The cover, along with the junction box cover and the shorting stick mounting fixture are equipped with interlock switches that prevent power supply operation if conditions are unsafe.

All electrical components in the beam power supply are chosen such that they operate well within their specified limits. For example, the voltage rating of the rectifiers is at least 2 times higher than the normal voltage applied to the rectifiers. Primary windings of the transformer are protected from line to line transient voltages by capacitors AND metal oxide varistors. A solid state metal oxide varistor mounted outside the oil in the junction box suppresses filter choke generated voltage surges. Resistors in series with each filter capacitor limit capacitor ripple and discharge currents, further extending the life of the capacitors.

4.7 Theory of Operation: HV Power Supply 380/415 V 50Hz

Refer to Schematic Dwg 839-8121-490 Sht. 2/2

The HV Power Supply consists of the following circuits: HV Contactor Assembly, HV transformer and Rectification/Filter circuitry.

4.7.1 HV Contactor Assembly

The 380/415V 4-wire 50Hz mains are connected to X1 L1, L2, L3 and X4 Neutral terminal blocks. HV Contactor Assembly command and control inputs are interconnected between the Interface panel X2/1-24 and the HV Power Supply terminal block X3/1-20. Switched primary power (380/415V 50Hz) is routed from the HV Power Supply terminal block X3/15-18 to the Interface panel terminal block X1/1-7. Q1 Beam Supply Isolator switch applies mains to Q3 150 Amp resettable breaker for HV Supply isolation. Q2 30 Amp breaker applies mains to the Transmitter cabinets. A 380/415V to 24VAC step-down transformer T1 provides 24 VAC to drive cabinet isolator K1. F1, F2, F3 provide over-current protection for the power line monitor and T1 step-down transformer. F4, F5, F6 provide over current protection for the HV Supply blower via adjustable current overload OL1 (0.38-0.68 Amp). R4-9 are Metal Oxide varistors that provide transient protection for the Transmitter Cabinets.

4.7.2 Control Circuitry

The Cabinet Isolator Switch on the rear of the transmitter provides a contact closure via X3/5 to ground to energize K1 in the HV Power supply. This applies mains voltage to the Contactor and Circuit Breaker assembly (Dwg 839-8121-450 Sht. 4/4). A power line monitor is provided to prevent circuit damage due to over/under voltage or phase loss. The trip points are variable and typically set for a +/- 5% window. The Phase monitor provides the Transmitter logic with a phase loss status to inhibit operation if the mains are not within the proper tolerance. Upon completion of Beam command the 1st step command is applied by the Transmitter logic via X3/6. The 1st Step command applies a

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ground to energize H1 Command Signal Present LED, the Thermal Interlock Normal LED H2 and Solid State Relay A1 via thermal interlock S1, S2, S3, the Fire Wire window detector and the HV transformer 155º C thermostats. Solid state relay A1 energizes and applies a ground to Beam supply contactor K3, which in turn energizes, applying 380/415V through R1, R2, and R3 step start resistors. Reduced primary voltage is then applied to HV Step Up transformer T1. Approximately one second after the HV 1st Step command Transmitter logic generates an HV 2nd Step command which applies 110VAC to energize Step start contactor K2 and Blower contactor K5. K2 effectively shorts out Step Start resistor R1, R2, R3 and applies the full mains voltage to the HV Step Up transformer primary. K5 is also energized via 2nd Step Command and applies power to the HV Power Supply blower. Upon completion of the 2nd step, the aux contacts of K2 close and apply a ground to illuminate H3 Step Start Complete LED. The HV Power supply is now at full beam potential. In case of crowbar fault Q3 will trip due to the instantaneous in rush current during the short circuit of the Beam. The logic will detect a crowbar fired signal and generate a breaker reset command via X3/20. This will energize M1 electric operator via the aux switch and K4 which will reset the breaker and return the transmitter to Beam after the appropriate step start sequence. The Transmitter logic also monitors the Command State versus Beam Status. If the logic detects Beam voltage after a Beam command is removed it will generate a shunt trip command to open Q3 and prevent damage to either HV Supply, Personnel or the IOT. The Beam Supply Breaker Tripped LED H4 will illuminate and may be reset utilizing S4 Beam Supply Breaker Reset Switch.

NOTE

Ensure transmitter is in standby state before initiating Beam Supply Circuit Breaker Reset Command. Failure to do so will bypass the step start sequence and apply overvoltage to the tube.

4.7.3 HV Rectifier Assembly

The three phase transformer has a delta connected, multi-tapped primary allowing a wide range of output voltages to be provided. One secondary is star connected the other delta connected; each feed a three phase bridge rectifier in a 12 pulse rectification system with low output ripple. The outputs from each rectifier bridge are added to provide the -32 kV output voltage. Additional filtering is provided by choke input filter L1 and C1. VDR1-5 is installed across the terminals of L1 to limit the EMF across the choke. R21/22 will limit C1 discharge current in the event of an internal tube arc/ crowbar occurance. R1-21 are connected across the output as a bleed network. The HV output connects between X1 As a safety measure a grounding switch is provided to discharge C1 during maintenance.

4.8 Theory of Operation: Contactor and Circuit Breaker Assembly

Refer to Schematic Dwg. 839-8121-450 Sht. 4/4

The Contactor Circuit Breaker Assembly is designed as a works in a drawer unit. It contains the Circuit Breakers, Contactor Drivers, Contactors and Power Supplies required to provide AC mains distribution in the transmitter.

4.8.1 Power Distribution

Primary power is routed into the Contactor and Circuit Breaker panel assembly from the HV Power Supply via the amplifier interface (Dwg 839-8121-465). The three phase 380/415V 50 Hz mains are applied to BX1/1, 2, 3, 7 internal jumpers then interconnect primary power to BX1/4, 5, 6. This provides a three phase power distribution bus to the Transmitter cabinet circuit breakers. Auxillary contacts in each of the breaker assemblies are utilized to provide a series circuit to indicate a System Normal status for the logic. When a circuit breaker trips this loop will open and extinguish the front panel System Normal LED. This circuit is output via BX7/1, 2. Functions of each circuit breaker with their associated current rating and contactor assemblies are listed below:

- Q1 Control PSU 6 Amp
- Q2 Cavity Blower 4 Amp K1.1.2.3
- Q3 Ion Pump & Bias 3 Amp K2.1
- Q4 IOT Heater 3 Amp K2.5, K5.4
- Q5 Cabinet Fans Front & Rear 3 Amp K2.3.4
- Q6 IPA Blower 3 Amp K3.1
- Q7 IPA PSU K5.1.2.3
- Q8 Focus PSU 3 Amp K6.1
- Q9 Crowbar Filament 3 Amp K2.2

4.8.1.1 Contactor Driver PCB

Power is derived from the Contactor Supply step down transformer T1. The 220VAC from Q1 is stepped down to 110, 85, 20VAC respectively. The 100VAC supply is routed to each of the opto isolated contactor drivers. The 85 VAC is applied to bridge rectifier V3 , C12, C11 to produce a 100 VDC output to drive the Beam Supply Contactor. H1 indicates the presence of the 100 VDC supply. The 20 VAC output is routed through a 5 amp fuse F2 and applied to bridge rectifer V1, C8 and zener diode V2 to produce a +24 VDC bus. H2 indicates the presence of the 24 VDC bus. The 24 VDC bus is distributed to the opto isolated contactor drivers, HV Beam supply, and the Isolated Meter Panel lights. F3 250 mA fuse provides protection for the HV power supply solid state relay A1 and LED indicators. F4 1 Amp fuse provides protection for the Isolated Meter Panel lights.

The Contactor Driver PCB receives command signals from the Logic & Control PCB contactor driver A86. Theset to the Contactor Driver PCB via BX6/1-17. A ground applied to the appropriate command line will energize the opto isolated contactor driver, A1-10. The contactor will then be actuated via BAX7/1-11 and primary power will be applied to the associated circuit. A Heater Hours Meter is provided and activates only during application of a Standby/Beam command.

Auxillary start contacts are provided on K4 to provide run commands for the pump module and heat exchanger via BX8/13, 14, 15, 16, 17, 18 during a BK Heat, Standby, or Beam Command sequence.

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Arc Test push buttons are provided to energize cavity arc sensor lamps via S1,S2 for the Output and secondary cavities respectively.

4.9 IOT Power Supplies

Power requirements for the IOT transmitter can be broadly split into two categories:

1. Conventional power supplies which are derived from the incoming line ac and sit at ground potential. We will call them NON ISOLATED supplies. for example the IOT focus power pack.
2. Conventional power supplies which are also derived from the incoming line AC but in this case the output voltage from the beam voltage at approximately -32/-36kV. These are ISOLATED POWER SUPPLIES; for example the IOT heater supply.

The AC line input from the line control cabinet is switched in the correct sequence to each of the supplies as shown in AC power Distribution Drawing.

Transmitters internal supplies are as follows:

1. TRANSMITTER CONTROL - a direct on-line MOV protected, single phase switched mode supply providing control and logic power requirements.
2. EXCITER RACK - an MOV protected, transformer input single phase switched mode unit serving the Exciters and system control functions for a dual Exciter System, paralleled supplies are provided.
3. IPA - Two 3-phase input, MOV protected, switched mode units with internal cooling operating in parallel.
4. FOCUS SUPPLY - A variable output single phase vendor supplied switch mode power supply. The unit supplies the electromagnetic focusing coils on the IOT circuit assembly.
5. CROWBAR HEATER - The crowbar cathode and its associated circuits are electrically bonded to the -30kV beam supply. The crowbar heater transformer is an ISOLATING air spaced transformer with adequate primary/secondary voltage separation.
6. IOT HEATER/ION/BIAS - The IOT heater/cathode sits at approximately -36kV. All three isolated supplies namely the Heater, Ion Pump and Bias have been brought together in a single unit and are supplied from two air spaced ISOLATING transformers. The Heater supply is a conventional full wave bridge, the Ion Pump is a voltage doubler circuit and the Bias a regulated supply fed from a raw full wave rectified voltage.
7. RF System Supply - +12 Volts DC in the Exciter cabinet supplies voltage for RF System Relays and logic.

4.10 Focus PSU

The Focus Current PSU is a vendor supplied unit designed to deliver up to 30 Amperes to the Beam focusing coil. A front panel mounted potentiometer is connected to the PSU to vary the output current from 18 Amps to 30 Amps. The supply is routed via BX2/1,2 to the IOT circuit assembly via interconnection harness.

4.10.1 Focus Current Overload PCB

The focus supply negative lead is routed via BCX1/1 to a meter shunt R11 and a current shunt R12. It then connects to BCX1/4 where it is in turn routed to BX2/2 and the interconnect harness. R11 provides drive for the front panel meter circuit while R12 provides a reference voltage to over/under current comparator A1, A2. Transorbs V3, V2 clamp input voltage excursions to 9.1VDC while C7,C6 provide decoupling.

Potentiometer R2 adjust a reference voltage for the under current trip point while R5 establishes the over current trip point. The Comparator outputs are the OR'ed together via A3A. The output from A3A drives V4 which in turn energizes K1 completing the Focus current normal status/interlock to the transmitter logic.

4.11 Theory of Operation: Isolated Supplies PCB

Refer to schematic Dwg's 839-8121-771 IOT HV Components and Cabling and 839-8121-288 Isolated Supplies 2 PCB assembly.

WARNING:

The Isolated Supplies PCB resides at a high voltage potential on the order of -36KV with respect to earth. Maintenance of any description should only be carried out when the transmitter has been isolated from the supply and earthed.

The Isolated Supplies PCB provides the operating voltages for the Ion Pump, Heater Supply, Regulated Grid Bias supply, and their associated Control and Monitoring circuitry. The supply outputs are routed via the isolated meter assembly and HV Umbilicle to the IOT/KLYSTRODE. A HV meter multiplier (1000:1) is also connected from the Isolated supply to ground potential to generate beam voltage metering capabilities.

4.11.1 Heater Supply

Circuit breaker Q4 applies 220 VAC to Black Heat contactor K2.5. During BK heat Rheostat R1a/b are placed in series with Rheostat R2a/b which effectively reduces the full filament voltage by a minimum of 1 VDC. Once Standby is selected, contactor K5.4 energizes to bypass rheostat R1a/b and apply full AC potential to T2 isolated heater supply stepdown transformer. Rheostat R2a/b is then adjusted to provide correct heater voltage for the IOT.

The Secondary of T2 applies a stepdown voltage of 8.9 VAC to V201 bridge rectifier. The DC output is filtered via C203 and C204. R215 provides protection to the filter caps by limiting

WARNING: Disconnect primary power prior to servicing.

inrush current on start up. The rectified filtered output is then applied to the IOT/KLYSTRODE heater via the HV Umbilicle cable. A parallel metering circuit is provided via R114 and R120 Heater meter cal pot.

4.11.1.1 Heater Proving Circuit

The Heater Volts is also monitored to provide a Heater OK readback to the transmitter logic. The voltage is monitored via a voltage sensing network composed of R130, R131, R107, V105, V117, V116, V107 and V106. If the voltage is between 5 VDC and 9.5 VDC, V107 will conduct which in turn will forward bias H102 providing a fiber optically isolated signal to the logic.

4.11.2 Ion Pump Supply

T1/2 provides an input voltage of approximately 1400 VAC. C201, V202 and V203 form a voltage doubler circuit with C202 providing the filter action. The output is in effect 3. to the Isolated PCB Deck.

The 3.4 kV Ion Pump voltage is then routed through the 50 mA series ion current meter and into the HV Umbilicle for connection to the IOT/KLYSTRODE. V1, V2 and R1 provide transient protection to the current meter to prevent damage of the movement during HV faults.

4.11.2.1 Ion Voltage Sensing

The logic has a proving circuit which looks for the Ion Pump voltage to be a least 1.8 kV. This is accomplished via a voltage divider network which comprises R202-R206 for negative reference and R208-R212 and V204 for the positive input to comparator A103. When the voltage is in range A103 conducts which in turn forward biases H101 providing a fiber optically isolated output to the control logic.

4.11.2.2 Ion Current Sensing

The current sensing network comprises R213, 3.6 V zener V205 and comparator A104. The positive input of the comparator is referenced to a level of -2 VDC established through divider R109 and R110. In the event current exceeds 20 mA A104 will go high and effectively reverse bias H104. This will extinguish the Ion Current OK signal to the logic.

4.11.3 Grid Bias Supply

150 VAC is supplied from T1/1 to fuse FS1, resistors R1 and R2 to bridge rectifier 1B8. The 150 VAC input is also applied via T3 to produce regulated logic supplies of +/- 12 VDC via bridge rectifier V101 and regulators A101, HA102. H105, H106 illuminate if supplies are in range. Bridge rectifier 1B8 positive output is referenced to 0V return while the negative output provides source voltage for the regulator circuitry. A1 provides a regulated voltage reference to bias pot R8 located on the Amplifier Cabinet rear wall below the isolated meter assembly. Varying R8 output voltage in turn controls the bias developed for V3,V4 which control the regulation of V9-16.

The variable 30-150 VDC output is then applied to an active crowbar circuit which comprise V39,V34 and FS3. The crowbar is designed to limit output current during a short circuit on the output of the supply.

R42, R43, V24 and V27 provide transient protection during a tube arc. The bias voltage is then applied through a series current meter P4 to the IOT/Klystrode via the HV umbilicle. Bias voltage metering is provided P3.

4.11.3.1 Bias Volts Proving Circuit

The bias voltage is monitored to ensure that it is between -35 to -150 volts. If the voltage falls out of this range V103 will go into cut off removing bias for H103 which will extinish the fibre optically isolated signal to the logic.

4.11.3.2 Bias Current Sensing

The bias supply is designed to be emmisive or receptive. Provision for monitoring current flow in either direction is achieved via R22, R23, R24, V18-23. Current flow in either direction will be developed as a input voltage to the +/- inputs of A2B. The output of A2B will be a voltage which is directly proportional to the current being emmitted/recepted from the IOT/Klystrode. This voltage will be compared in A2A with a preset reference (R38) to establish a trip point. If current exceeds +/-100ma trip point, A2A will bias V26 into conduction and effectivly reverse bias H1 grid bias current opto isolator. The output will be applied to the logic and interlock the Beam Off.

4.12 Crowbar General Description

Refer to the circuit diagrams 839-8121-745 the crowbar assembly and 839-8121-744 the Floating Deck Unit.

WARNING:

The IOT Crowbar Assembly resides at a high voltage potential on the order of -36KV with respect to ground. Maintenance of any description should only be carried out when the transmitter has been isolated from the supply and grounded.

The IOT crowbar is in effect a high voltage, optically controlled shunt switch. Its purpose is to protect the IOT from adverse damage in fault conditions i.e internal tube arcs. Under such conditions an unprotected tube will draw excessive current from the HV power supply and the energy stored in the decoupling capacitors will additively contribute to effects causing possible damage to the tube.

During a tube arc or HV cable fault the crowbar detects the sudden rise in current drawn from the supply. This causes it to self trigger or turn on. The heart of the crowbar, a deuterium thyratron, diverts any follow on energy from the supply away from the IOT thereby preventing further damage.

Upon triggering, the crowbar informs the amplifier control that a fault has occurred causing the crowbar to fire and the HV breaker is turned Off.

4.12.1 Crowbar Construction

The crowbar assembly consists of a base plate at ground potential to which the isolation transformer is mounted. An electrically floating chassis at the full beam voltage under normal operating conditions is isolated from ground potential by four insulated standoffs.

WARNING: Disconnect primary power prior to servicing.

The floating chassis provides a means of attaching the Thyratron device and its associated control circuitry consisting of the Floating Deck Unit, the FDU/Thyratron Interface PCB and power supply. As a result of the heating effects of the Thyratron device, a DC fan is used to provide sufficient airflow onto the base of the device to prevent overheating and pre-triggering.

Fuses for the secondary of the FDU transformer are located on a horizontal flange of the chassis. Two more insulating standoffs are fixed to the floating chassis, one to provide support to the IOT supply series resistors, the other providing support for the Grading Grid divider and Crowbar Fired detector.

Connections to the crowbar take the following form:

- Variable single phase AC mains input on isolating transformer.
- Base plate connected to ground.
- Chassis connected to negative side of beam supply.
- Series resistors connected to isolated supplies assembly.
- Thyratron anode connected to body current resistor via stud at top of pillar.
- FIRE CROWBAR and CROWBAR READY fibre optic interface.
- CROWBAR FIRED connected via BNC to transmitter bulkhead.
- Damping capacitor and surge limiting resistor connected between Thyratron cathode and anode.

4.12.2 Crowbar Detailed Circuit Description

4.12.2.1 Floating Deck Unit

The Floating Deck Unit, or FDU, provides the positive and negative DC bias voltages for grid 1 and grid 2 of the deuterium filled double gap Thyratron. In addition to the bias, the FDU also generates the grid 1 status signal which is passed to the main control logic as a Crowbar Ready signal and receives the indirect FIRE CROWBAR trigger pulse on command from the main logic assembly for test purposes.

The 6.3V nominal supply for the heaters is applied to the step up transformer T2 whose secondaries provide the FDU with (-100)-0-(+100) Volts RMS at X1/3 - X1/1&2 - X1/4 respectively.

AC power supply monitoring is provide by two identical LED driver circuits, one consisting of R19, R20, V10 and H3.

The AC supply is bridge rectified by V1 and filtered by C1, C2 to provide the unit with the +140 VDC required for grid bias purposes, while the full 280 VDC is supplied to the FET pulse generator.

Local supplies of 15 V with respect to 0 V, 18 V with respect to -140 V and 5 V with respect to -140 V are provided by zener diodes V9, V2 and regulator A3 respectively.

The indirect or manual trigger pulse enters the module via optical fiber and is detected by H1. The signal is buffered by A2B before being passed to the FET pulse generator V5 which in turn pulses the primary winding of T3.

T3 secondary picks up the DC negative bias for grid 2 via R18 and C11 and is preloaded by R17. C10 acts as the local source of power for the pulse generator.

The associated diodes in this section of the circuit provide reverse and over-voltage protection for the FET driver V5.

The CROWBAR READY signal is generated in the following manner:

- Current flowing to grid 1 from the +140 VDC supply is monitored by R6 and fed to the optical isolator V11 via clamping and limiting diodes V12 and V13.
- The output from V11 controls the collector circuit of V14 which has its base voltage derived from a protective and level setting zener diode chain V15 and V16 monitoring the DC voltage on grid 1. Diode V19 provides grid 1 transient overvoltage protection which may be induced due to aging of the Thyratron.
- This voltage is interlocked via a thermostat mechanically fixed to the base of the Thyratron.
- In order that V14 may pass current to the optical transmitter H2, both base and collector voltages and cooling to the Thyratron must be present, indicated by thermostat S1. This condition is indicative of the Thyratron being in a condition ready to fire. H2 relays this Ready condition via fiber optic cable to the main logic assembly.
- Bias and trigger voltages are supplied to the Thyratron via the FDU/Thyratron Interface PCB

4.12.2.2 FDU/Thyratron Interface PCB

The interface PCB provides the following four functions:

- Electrically connect the bias voltages and test mode trigger signal to the Thyratron.
- Direct mode triggering is derived from the current transformer CT2, R1, R2 and C2, C3.
- Rectification and filtering (V1, V2, C5) of the Thyratron heater supply to supply the Thyratron cooling fan, U1.
- Two fuses are provided for the protection of the Thyratron cooling fan and the primary circuit of the FDU power supply.
- Thyratron filament metering is accomplished via bridge rectifier V3 and filter capacitor C7. R6 provides a means to calibrate M1 to indicate filament voltage.

4.13 IOT LOGIC Circuit description

4.13.1 Digital and Analog Interface PCB

(Refer to DWG 839-8121-151 Sht. 1-8)

The Digital and Analog Interface PCB comprises the following circuits: Decoupling, Supply Monitoring, Power Metering, Crowbar Control, Status Inputs 1, Status Inputs 2, and Remote Status Drivers.

These circuit are shown on the front page of the schematic as subassemblies of the schematic and are referenced by page number.

4.13.1.1 Power Supply Monitoring

Battery G1 is used to supply the latches during a power failure. In normal circumstances the battery is trickle charged from the +5V supply via R91 and V22. The supply voltage for the battery backed parts of the circuit (Vbat) are derived from A29 which

WARNING: Disconnect primary power prior to servicing.

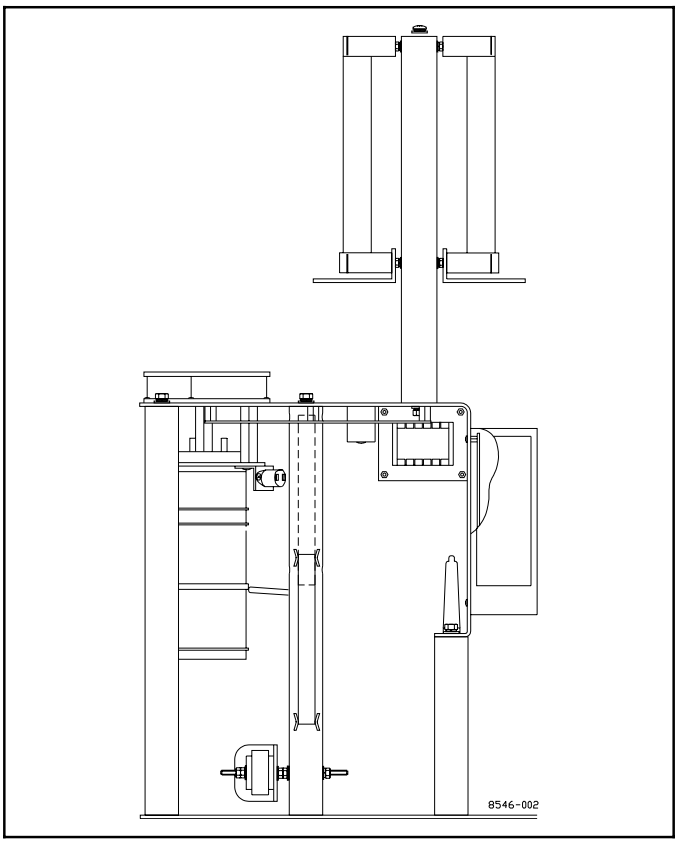

Figure 4-1. Crowbar Assembly Parts Location

automatically selects the battery or +5V depending upon which is the greater.

A30 is used to monitor the 5V supply with the output being low when the voltage is greater than 4.8V and high if the supply is less than 4.6V.

Detection of the +24V supply is performed by V90, V89 and optoisolator A43D while V25, V24, V23 detect the +12V supply and V26, V27 and optoisolator A43C detect the -12V supply.

The outputs from the voltage detectors are AND'ed together in A6B, A6C and A51B. This combined detection is then fed to the monostable A31A and A31B which introduce two delayed on signals (P_WAIT and POWER_OK) which are used to indicate good supplies. These signals are used to perform sequenced Power Up and Power Downs within the logic. An inverted POWER_OK signal (N_POWER_OK) is generated by A38D and is fed to those sections that require an inverted signal. The final power supply signal N_PWR2_OK is AND'ed with the output from A35B which is triggered when the crowbar fires and is used to prevent spurious trips from occurring.

4.13.2 Power Metering

4.13.2.1 Forward Power and IPA power metering

Foward Power, VSWR and IPA power metering are performed by identical circuits. Therefore, only the Forward Power will be described with IPA reference numbers in {}.

Incoming RF arrives on the board through X3 {X4}, a SMC coaxial socket and is fed to diode detector V13 {V12}. The demodulated signal is then buffered in A50A {A50B} before being fed to a peak detector consisting of V80 {V81}, V84 {V85}, and A2A {A2D}. Meter calibration is performed by A2B {A3A} and R51 {R48} with a feed going to level detector A2C {A3B} and R50 {R49} to provide a logic '1' when the signal is greater than the voltage on the wiper of pot R50 (R49).

4.13.2.2 Reflected Power Metering

(See Fig. 4-3)

Reflected power metering RF arrives on the board through X5 , a SMC coaxial socket and is fed to diode detector V11. A sound notch filter consisting of C3, C7 and L2 can be inserted into the circuit by setting X11 to its top position. The demodulated signal is then buffered in A3C before being fed to a peak detector consisting of V4, V86, and A3D.

Meter calibration is performed by A4A and R46 with a feed going to level detector A4B and R47 to provide a logic '1' when the signal is greater than the voltage on the wiper of pot R47.

4.13.2.3 IPA Power Normal

The serial data stream from the IPA module is fed to the Interface PCB via X29 a SMC coaxial socket and is then fed into retriggerable monostable A35A. X30 is used to select whether or not the output from A35A is AND'ed with the output from the IPA level detector in A48D. If Link X30 is in the b to c position then IPA Normal will only occur when there is data present AND the output level is Normal.

4.13.3 Crowbar Control

The output from the collector current detector is fed to monostables A7A and A7B after passing through the voltage clamp V14 and current limiting resistor R59. A sample of the clamped signal is then fed to the power supply monitoring as PRE_COG in order to shutdown the supplies in the event of a crowbar firing. A7A is used to stretch the pulse feed to the LED display latches and the external output via A1A, V1 V3 and X2 which is used to reset the breaker.

The output from A7B is AND'ed in A48B with the crowbar ready signal so that in the event of the crowbar firing the ready signal disappears for at least a second. A8A and A8B are used in conjunction with S1 to produce the firing pulses that are fed to fiber optic transmitter H2 to trigger a manual crowbar firing.

4.13.3.1 Status Inputs 1

All analogue status indications are routed to the Status Inputs 1 schematic. Here they are converted to logic levels to provide status indications to the transmitter Control logic.

4.13.3.1.1 Supply Present

Supply Present iisolator A1C and is then buffered by inverter A5D.

4.13.3.1.2 Internal Interlock

(Refer to Fig. 4-14)

Internal Interlock indication comes in via opto isolator A1D and is then buffered by inverter A37A with H7 being illuminated when the circuit is made.

WARNING: Disconnect primary power prior to servicing.

4.13.3.1.3 Panel Interlock

(Refer to Fig. 4-12)

Panel Interlock indication comes in via opto isolator A39A and is then buffered by inverter A5B with H8 being illuminated when the circuit is made. X22 can be used to set the Panel Interlock permanently OK.

4.13.3.1.4 External Interlock

(Refer to Fig.4-11)

External interlock indication comes in via opto isolator A39B and is then buffered by inverter A32F, X26 can be used to set the External Interlock permanently OK.

4.13.3.1.5 IPA Air Normal

The IPA Air Normal indication comes in via opto isolator A39C and is then buffered by inverter A32A before being fed to the anti-flutter circuit of monostable A44A and A33A.

4.13.3.1.6 Cavity Air Normal

The Cavity Air Normal indication comes in via opto isolator A39D and is then buffered by inverter A37F before being fed to the anti-flutter circuit of monostable A44B and A33C.

4.13.3.1.7 Low Heaters Normal

The Low Heaters signal comes in via fibre optical receiver H12 and is then buffered by inverter A32B.

4.13.3.1.8 Full Heaters Normal

The Full Heaters indication comes in via opto isolator A40A and inverting buffer A34B. Finally the signal is AND'ed with the Low Heaters Normal signal in A33B before passing on to the next part of the circuit.

4.13.3.1.9 ION Pump Volts OK

The ION Pump Volts OK signal comes in via fibre optic receiver H13 and is the buffered by inverter A32D.

4.13.3.1.10 Motor Overloads

(See Fig.4-9)

Motor Overloads 1, 2 and 3 arrive via opto isolators A41D, A1B and A40B and the faults indicated on H11, H10 and H9 respectively. The three signals are then NAND'ed in A49A to provide one motor overload fault signal for all three inputs.

4.13.3.1.11 Focus Normal

The Focus Normal indication comes in via opto isolator A40C and is then buffered by inverter A5F.

4.13.3.1.12 Cooling Status

Cooling Status's 1, 2 and 3 arrive via opto isolators A42A, A42D and A42B and the state is indicated on H17, H18 and H19 respectively. The three signals are then NAND'ed in A36B to provide one cooling OK signal for all three inputs. Links X24 and X25 can be used to set cooling 2 and 3 respectively to normal if they are not in use. (Air Cooled Systems Only)

4.13.3.1.13 HV Circuit Breaker Normal

The HV Circuit Breaker Normal indication comes in via opto isolator A40D and is then buffered by inverter A32E.

4.13.3.1.14 IPA PSU Normal

The two IPA PSU signals arrive via opto isolators A42C and A43A respectively, these signals are then NAND'ed together in A34A to produce the IPA OK signal.

4.13.3.1.15 Cabinet Temperature

The Cabinet Temperature indication comes in via opto isolator A41A.

4.13.3.1.16 ION Pump Current

(See Fig. 4-10)

The ION Pump Current signal enters the logic via fiber optical receiver H15, the signal is then AND'ed with the inverted TX OFF signal from A5E in A48C.

4.13.3.1.17 HV 2nd step

(Refer to Fig. 4-4)

The HV 2nd Step made normal indication comes in via opto isolator A41B and is then buffered by inverter A37C.

4.13.3.1.18 Amplifier Normal

(Refer to Fig. 4-5)

The Amplifier Normal indication comes in via opto isolator A41C and is then buffered by inverter A37D.

4.13.3.1.19 Reject Power

(Refer to Fig. 4-7)

The Reject Power indication comes in via opto isolator A43B and is then buffered by inverter A37E.

4.13.3.1.20 Bias Over Current

The Bias Over Current signal enters the logic via fiber optic receiver H16 and is then filtered by R276, R277 and C79 to remove any spurious pulses. The TX OFF signal is fed through a one way delay comprising of V88, R282, R283 and C82, this signal is then inverted in A5C and AND'ed in A51A with the filtered input from H16. A further AND action then takes place in A51C with the HV Normal signal. The final output is the Bias Over Current signal.

4.13.3.1.21 Bias Volts OK

The Bias Volts OK signal enters the logic via fiber optic receiver H14 and is then NAND'ed by A34C with the filtered Bias Over Current signal.

4.13.3.1.22 Primary Cavity Arc Detector

A4C is a used as a comparator to measure the resistance of a light dependant resistor mounted in the klystron cavity. When the resistor 'sees' the light from an arc or flash light its value drops and the comparator output goes high. V78 and V55 are clamp diodes used to stop large differential voltages and to ensure that the op-amp does not latch up.

4.13.3.1.23 Secondary Cavity Arc Detector

A47C is a used as a comparator to measure the resistance of a light dependant resistor mounted in the IOT/Klystode cavity. When the resistor 'sees' the light from an arc or flash light its value drops and the comparator output goes high. V79 and V59 are clamp diodes used to stop large differential voltages and to ensure that the op-amp does not latch up.

WARNING: Disconnect primary power prior to servicing.

4.13.3.1.24 Tube Over Temperature

(Refer to Fig. 4-8)

A4D is an op-amp arranged to amplify the signal from a resistive bridge, one element of which is either a thermistor or a thermostat. The signal is then amplified by X10 in A45B before being fed to the trip circuit of A45A. Trip adjustment is set by putting link X27 into position b-c and adjusting R238 until the trip point is found.

4.13.3.1.25 HV Voltage Metering

This input from the High Voltage Meter Multiplier is filtered by L3, L4, R256, R257 and C55 before being amplified in differential amplifier A46C. A46B in conjunction with R239, form an adjustable gain amplifier that provides the local and remote HV metering outputs. A sample of the metering output is fed to a voltage comparator A46A which compares the HV metering level with the voltage produced by divider R194 and R195. If the metering output is higher than the divider then the output from A46A goes high to signal HV Normal.

4.13.3.1.26 HV Current Metering

This input from the high voltage current meter shunt is filtered by L5, L6, R258, R259 and C56 before being amplified in differential amplifier A45C. A47D in conjunction with R240, forms an adjustable gain amplifier that provides the Local and Remote HV current metering outputs. Output offset adjustment is provided by R255 feeding the non inverting input of A47D. A sample of the metering output is fed to a voltage comparator A45D which compares the current metering level with the voltage produce by pot R241. If the metering output is higher than the divider then the output from A45D goes high to signal a HV Current Fault.

4.13.3.1.27 Body Current Metering

(Refer to Fig. 4-15)

This input from the body current meter shunt is filtered by L7, L8, R260, R261 and C57 before being amplified in differential amplifier A46D. A47B in conjunction with R243, form an adjustable gain amplifier that provides the local and remote body current metering outputs. Output offset adjustment is provided by R253 feeding the non inverting input of A47B. A sample of the metering output is fed to a voltage comparator A47A which compares the current metering level with the voltage produce by pot R242. If the metering output is higher than the divider then the output from A47A goes high to signal a body current fault.

4.13.3.1.28 IPA Reset

The latched indication reset line is inverted by A36D before being fed to tri-state buffer A22D and then on to the IPA via R251 and X9.

4.13.3.2 Open Collector Outputs

All indications are available remotely as open collector transistors that turn on to indicate a status or a fault. There are four sections providing a total of 32 non latched outputs.

Section 1 consists of buffer A10, open collector array A9 and tri-state buffer A11A. In the event of the power supplies being low then the input buffer is inhibited from N_POWER_OK and the open collector outputs disabled by POWER_OK in order to prevent any spurious indications.

Sections 2, 3 and 4 are identical but use the following gates, A13, A12, A11B for section 2, A15, A14, A11C for section 3 and A26, A25, A122B for section 4.

There are also two sections providing 12 latched outputs, three selectable outputs and one non-latched output in total. Section 1 consists of buffer A17, open collector array A16, tri-state buffer A11D and battery powered latched A18 - A19. In the event of the power supplies being low then the input buffer is inhibited from N_PWR2_OK and the open collector outputs disabled by POWER_OK in order to prevent any spurious indications.

The second section works in the same way but uses A21, A20, A22A and A23 - A24. All the remote latches are reset when the RESET line is high either by pressing the reset button on the front panel when the Local/Remote switch is in Local or remotely when the Local/Remote switch is in Remote. Input T24 (HV 2nd step fail) does not have a latch associated with it, while T25 (Lockout) can be either by moving X28. The same is true for T38 (Amplifier normal) with X12 and T39 (Reject power) with X13.

4.13.4 Digital and Analog Interface PCB

4.13.4.1 LEDs (Description)

- H3 Power supplies OK.
- H4 -12V
- H5 +24V
- H6 +12V
- H7 Internal Interlock
- H8 Panel Interlock
- H9 Motor Overload 2
- H10 Motor Overload 3
- H11 Motor Overload 1
- H17 Cooling 1
- H18 Cooling 2
- H19 Cooling 3

4.13.4.2 Link Settings

X22	link to defeat panel I/L
X26	link to defeat external I/L
X25	link to defeat external I/L
X24	link when cooling 2 is not used
X25	link when cooling 3 is not used
X27	*a-b link for normal operation
	b-c link for Tube overtemp setup
X12	a-b link for Go Home remote O/P latching enabled
	*b-c link for Go Home remote O/P latching disabled
X13	*a-b link for Reject Power remote O/P latching enabled
	b-c link for Reject Power remote O/P latching disabled
X28	a-b link for lockout remote O/P latching enabled
	*b-c link for lockout remote O/P latching disabled
X30	*a-b link for no data stream from IPA
	b-c link for data stream from IPA

* = normal position

WARNING: Disconnect primary power prior to servicing.

4.13.4.3 Adjustments

R238	Over Temp trip
R239	HV meter gain
R240	Current meter gain
R241	Current meter trip level
R243	Body current meter gain
R242	Body current trip level
R51	Vision O/P power gain
R50	Vision power normal trip level
R48	Vision IPA power gain
R49	Vision IPA power normal trip level
L2	Reflected vision combined sound reject notch
R46	Reflected vision combined meter gain
R47	Reflected vision combined over power trip level

4.14 Logic and Control PCB

(Refer to Sch. 817 2336 172 Sht.1-15)

4.14.1 Remote Controls

(Refer to Sch. 817 2336 172 Sht.3)

The five remote transmitter controls are opto isolated in A55A-A55D and A56A with the operating voltage being selected by link X15 - X19. If a link is fitted then operation is from 5V to 12V, if the link is not fitted then operation is from 12V to 24V. Transorbs V3 - V7 are for transient protection above 28V. X14 is used to select where the voltage for the opto-isolators comes from. In position a-b the Transmitter's 24V supply is used while in position b-c an external voltage is needed.

4.14.2 System Controls

(Refer to Sch. 817 2336 172 Sht.4)

The five system controls consist of opto-isolator inputs A56B, A56C, A56D A57A and A57B which are fed from a fixed 24V supply.

4.14.2.1 Control Actions

(Refer to Sch. 817 2336 172 Sht.2)

The outputs from the remote controls and the system controls are OR'ed together and connected to one half of a five pole change-over switch made up from a set of CMOS switches A50, A51 and A52. Local switches on the front panel connect into the other half of the switch. Switching is controlled by the local remote switch output R30 and inverter A41D. Local controls can be enabled continuously by linking X13 to position a-b. If link X13 is in position b-c then the front panel controls will only operate when Local is selected on the Local/Remote button. When a button is pushed that input to priority encode A44 goes low and at the same time the output from NAND gate A45 will go high triggering monostable A40B. The Q output from A40B is buffered in A72A and used to produce a narrow reset pulse for the latches in A47. At the same time the output from the priority encoder A44 is fed via buffer A46 to the Transmitter State latches in A47.

A priority encoder is used to prevent more than one button being pressed at a time. The priority system is arranged to make OFF the highest priority with BLACK HEAT, STANDBY and BEAM in order of descending priority. A42B, A42C and A42D in conjunction with X10 to X12 can be used to determine the action of the transmitter in the event of a LOCKOUT occurring. See link setting table for actions.

Switch S9 is used to select either Local control or Remote control, each time S9 is pressed the control will alternate between Local and Remote. When S9 is pressed it produces a pulse that is fed to retriggerable monostable A80A which produces a pulse approximately 0.1 seconds long. The pulse is then fed into a bistable latch consisting of A63A, A63B, A48A, A48B, A81D and A94, for each pulse the latch will change to the opposite state. The status is stored during power absence in A81 and A94 which are supplied from the backup battery.

4.14.2.2 Oscillator

(Refer to Sch. 817 2336 172 Sht.8)

A73 in conjunction with B1 form a 32kHz oscillator that is divided down in A73 and A95 to produce the various clock signals used by the logic (CLK1 runs at a 1Hz rate).

4.14.2.3 Collector Cooling timer

(Refer to Sch. 817 2336 172 Sht.5)

The Collector Cooling timer consists of a presetable counter comprising of A66, A67 and A68 whose outputs are compared in A65 to the required count. When the counters have reached their designated count the output from A65 goes low, and if the second input on A64A is also low, then the collector cooling will be turn the output of A65 will also stop any further count by ck input from getting through AND gate A63C. A64C looks at whether Standby or Beam control is selected and turns the collector cooling On via the second input on A64A if either of these two inputs are present. The inverted output from A64C is AND'ed with the normally high POWER_OK signal, this signal is used to reset the counters to 0 in the event of a power failure or when the transmitter is switched to Standby or Beam. The P_WAIT signal is a delayed POWER_OK that is used to pre-set the counter to its final count upon a power up with the transmitter not switched to Standby or Beam.

4.14.2.4 Cavity Cooling Timer

(Refer to Sch. 817 2336 172 Sht.6)

The Cavity Cooling Timer consists of a presetable counter comprising of A59, A60 and A61 whose outputs are compared in A58 to the required count. When the counters have reached their designated count the output from A58 goes low and if the second input on A77D is also low then the cavity cooling will be turned Off. A low on the output of A58 will also stop any further count by stopping the clock input from getting through AND gate A70B. A71B inverts the Off control and turns the cavity cooling On via the second input on A77D if Off is not selected. A76B AND's the normally high POWER_OK signal with the Off signal, this signal is used to reset the counters to 0 in the event

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of a power failure or when the transmitter is not switched to Off. The P_WAIT signal is a delayed POWER_OK that is used to pre-set the counter to its final count upon a power up with the transmitter switched to Off.

4.14.2.5 120 Second Delay

(Refer to Sch. 817 2336 172 Sht.12)

The 120 Second Delay is used between Background Heat and On or Standby and produces a nominal delay of 120 seconds, this delay is set by switches S3 and S4 and can be adjusted according to the tube manufactures data. A6 and A7 form a presetable counter set by S4 whose output is compared in A10 to the count set by S3. The low when count output from A10 is then inverter in A4B to provide a high when count signal output. A low on the output of A10 inhibits any further counts by being AND'ed with the clock in A8B. The Low Heaters OK signal is then AND'ed in A8D with an Off signal. A8D's output is then OR'ed with the Background Heat from A3C. The output from A8D then used to further AND the clock in A8A before the clock arrives at the counters. An output from monostable A9A which produces a delayed pulse from POWER_OK is AND'ed in A8C before being used to reset the counters A6 and A7. The net result of this is to reset the counter after a power fail and to stop the clock if off or background is selected.

4.14.2.6 B-Heat Timer

(Refer to Sch. 817 2336 172 Sht.11)

The B-Heat Delay is used on Background Heat to produces a nominal delay of 600 seconds, this delay is set by switches S7 and S8 and can be adjusted according to the tube manufactures data. A37, A38 and A39 form a presetable counter whose count is set by S7 and whose output is compared in A36 to the count set by S8. When two counts being fed into A36 are equal, then the output from A36 goes low. The output from the counter is then inverted in A4F to provide a high when the count signals are equal. A low on the output of A36 will inhibit any further counts by being AND'ed with the clock in A43A. The clock signal going through A43A is also AND'ed with a signal derived from A41A and A42A that only enables the clock if the transmitter is not switched to Off and there is a Low Heater Volts OK signal. The output from A42A is AND'ed in A20D with delayed POWER_OK signal S_DELAY before being used to reset the counters A37, A38 and A39. A mains holdover delay is produced by charging C5 via buffer A35B, R34 and blocking diode V2, when the Standby Delay is set or the counts are equal. When C5 is charged, if the power supplies disappear C5 will discharge slowly through R35. When the power supplies are restored if C5 has not discharged below the threshold of tristate buffer A35C then the counters will be told to preloaded via A32B, thus keeping the counter set after a short mains break.

4.14.2.7 Standby Timer

(Refer to Sch. 817 2336 172 Sht.10)

The Standby Delay is used on Standby to produces a nominal delay of 300 seconds, this delay is set by switches S5 and S6 and can be adjusted according to the tube manufactures data. A29, A30 and A31 form a presetable counter whose count is set by S5 and whose output is compared in A28 to the count set by S6. When two counts being fed into A28 are equal, then the output from A28 goes low. The output from the counter is then inverted in A4E to provide a high when the count signals are equal. A low on the output of A28 will inhibit any further counts by being AND'ed with signal is AND'ed with a signal derived from A33A and A92D that only enables the clock if the transmitter is switched to Standby or Beam and there is a Full Fils OK signal. The output from A92D is AND'ed in A20C with delayed POWER_OK signal produced by monostable A9B. S_DELAY is also fed to the Background Delay timer. The output from A20C is used to reset the counters A29, A30 and A31. A Mains Holdover Delay is produced by charging C3 via buffer A77A, R26 and blocking diode V1, when the background delay is set or the counts are equal. When C3 is charged, if the power supplies disappear C3 will discharge slowly through R27. When the power supplies are restored if C3 has not discharged below the threshold of tristate buffer A35A then the counters will be told to preloaded via A32A, thus keeping the counter set after a short mains break.

4.14.2.8 Fault counter

(Refer to Sch. 817 2336 172 Sht.7)

Three shot trips are fed into OR gate A75 whose output is then AND'ed in A70D with the beam signal to let only three shot trips occur when the Transmitter is switched to Beam. When a three shot input occurs the output of A70D triggers monostable A91B. The /Q output from A91B causes counter A78 to increment by one and is AND'ed in A5C with the ready signal, this momentarily causes the transmitter to come off HT and then go back on (extinguish any arcs). A70C looks at the outputs of A78 and depending upon the setting of link X20 will produce a high output after a count of either 4 or 5. The output goes to two places, first to OR gate A33B which sets the lockout latch and secondly to inverter A71E in order to enable AND gate A76A. Buffer A48C feeds the Q output from A91B to set latch A81B which is used to remember that a trip has taken place. The output from latch A81B is AND'ed in A76A and fed to A85A in order to enable the clock for the 30 second counter. The other input to A85A is controlled from the output of comparator A82 which is fed in turn from counters A83 and A84. The output from the countput from A82 g. A64D OR's the inverted output from A82 and the reset line and feeds onward to buffer A48D to reset the 3 shot occurred latch A81B. The output from A64D also resets the 3 shot counter A78 so that if a trip has not occurred in the last 30 seconds then the three shot counter has to start again. All single shot trips are fed through OR gates A74 and A79 into OR gate A33B, which OR's the output from the 3 shot counter and then feeds the signal through buffer A72B into lockout latch A81A the output of which is fed to the rest of the logic via buffer A72C. The lockout latch A81A is reset through inverter A71C and buffer A72D.

4.14.2.9 Contactor Drivers

(Refer to Sch. 817 2336 172 Sht.13)

Cabinet Temperature and Motors Overload are OR'ed together in A33C, any trip occurring on either of these inputs will set latch A81C via buffer A35D. AND gate A90C together with A85C

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AND the Panel Interlock with the Delayed Power OK signal P_WAIT and the inverted (A87D) state of the Cabinet Overtemp/Motors Overload latch drives the input latch the open collector driver A86. At the same time A87A provides an inverted signal to clear the latch. All the output transistors in A86 are disabled by the output enable pin 22 driven from N_POWER_OK until it goes low when the power supplies are good. The latch A81C is reset from the inverted reset line via A41E. Cavity Cooling is turned on from the output of the Cavity Cooling Timer circuit fed into A86 pin 4. The Low Filaments drive is derived from a NOT off signal from A87C AND'ed in A88D with the Cavity Air Normal and then fed to pin 3 of A86. Collector Cooling is turned on from the output of the Collector Cooling timer circuit fed into A86 pin 6. A77B produces an OR'ed signal from the Standby and Beam signals to one input of AND gate A85B. The other input to A85B is fed from a 20 second Low to Full Heaters signal produced by monostable A40A OR'ed with the output from the Full Filaments timer in A77C. The output from A85B is AND'ed with IPA Air the Low Heating fed to A86 pin 5. The HV 1st step is drive signal is derived from the NOT Lockout signal produced by A87B AND'ed with the Ready signal in A85D AND the Beam signal in A88A. The output from A88A then triggers monostable A80B and charges C18 via R137. A88B then AND's the /Q output from A80B with the delay signal from C18 to drive A86 pin 7. The output from A88B HV 1st step is then used to trigger monostable A89A and the start C21 charging via R141. A43C then AND's the NOT lockout signal from A87B with the /Q output of A89A and capacitor C21 and drives the 2nd step output transistor on A86 pin 8. As the HV 2nd step is turned on monostable A89B is triggered and the /Q output goes low and C23 is charged via R145. A87E inverts the incoming 2nd Step Normal signal and feeds this signal via test link X26 to AND gate A90A which produces a HV 2nd Step Fail signal when all three inputs are high. A87F produces an inverted Beam signal which is used to charge capacitor C25 via R149 and to trigger monostable A91A when the transmitter is switched from Beam to any other control state. AND gate A90B produces a high signal to fire the shunt trip via A86 when the transmitter is not on Beam and C25 is charged and the /Q output from A90B is high.

4.14.2.10 Led Drivers

(Refer to Sch. 817 2336 172 Sht.14)

All indications are available LEDs that turn On to indicate a status or a fault. There are three sections providing 24 non latched indications in total. Section 1 consists of buffer A15, open collector array A14 and tri-state buffer A13B. In the event of the power supplies being low then the input buffer is inhibited from N_POWER_OK and the open collector outputs disabled by POWER_OK in order to prevent any spurious indications. Sections 2, 3 and 4 are identical but use the following gates, A12, A11, A13A for section 2 and A17, A16, A13C for section 3.

There are also two sections providing 12 latched outputs, three selectable outputs and one non-latched output in total. Section 1 consists of buffer A19, open collector array A18, tri-state buffer A13D and battery powered latches A21 - A22. The LEDs can only be reset when the Transmitter is switched to Local and the front panel Reset button has been pressed. This action is achieved by inverting the LOC\REM signal in A4C and AND'ing the inverted signal with the reset line in A20A before passing the reset to the latches via tristate buffer A32A. In the event of the power supplies being low then the input buffer is inhibited from N_PWR3_OK and the open collector outputs disabled by POWER_OK in order to prevent any spurious indications. Section 2 consists of buffer A25, open collector array A24, tri-state buffer A23B and battery powered latches A26 - A27. The LEDs can only be reset when the transmitter is switched to Local and the front panel reset button has been pressed. This action is achieved by inverting the LOC\REM signal in A4D and AND'ing the inverted signal with the reset line in A20B before passing the reset to the latches via tristate buffer A23C. In the event of the power supplies being low then the input buffer is inhibited from N_PWR3_OK and the open collector outputs disabled by POWER_OK in order to prevent any spurious indications. Input T24 (HV 2nd step fail) does not have a latch associated with it, whilst T25 (Lockout) can be either by moving X2. The same is true for T38 (Amplifier Normal) with X8 and T39 (Reject Power) with X9.

4.14.2.11 Power Control

(Refer to Sch. 817 2336 172 Sht.16)

Power Down/Power Up switches S18 and S19 respectively apply a contact closure to ground. This in turn fires Inverting Schmidt Trigger A96D/A96E which provides a logic 1 to Exclusive Or A101C. A101C in turn drives Local Remote selector switch A106. Section 2 of A106/P7 provides an enable to A102C/P11 and in the presence of a clock (A102/P9) pulses A103/P1 Digital Pot. Section four of Selector switch A106/P12 provides the U/D enable to Digital Pot A103/P2. The Digital Pot A103 receives the Power Up/Down (Local or Remote), Clock 2, Clock 3 signals to increase or decrease the output voltage which in turn will be used to drive the amplifier cabinet AGC and UHF Linearizer power control pot input.

4.14.2.12 Power Selector

(Refer to Sch. 817 2336 172 Sht.17)

The power selector circuit provides three functions. Power normal detection, Analogue output buffering, and front panel meter selection. The Power Monitor assembly provides a detected dc voltage which is proportional to the transmitter output power, (Peak Power Visual, Black Level Visual, Aural 1/Aural 2, Exciter Power) via IDC connector NX36.

In this discussion Peak Visual Power signal path will be described. NX36-12 provides a DC voltage relative to Peak Visual power to A113B/5 Op Amp. A reference voltage is provided via R182 and potentiometer R183 to A113B/6. If the detected DC voltage falls below the preset reference A113B/7 will pull low and extenguish the front ponel Power Normal LED (I21) via diode Or Gate V36. This signal is also routed via NX29/1-16 to the Interface PCB to drive remote status monitoring via RX32/3,4,5,6. System power meter buffering is accomplished via A109/A113 which in turn drives the remote analogue metering outputs via NX53 and RX2(Interface PCB 817-2336-190).

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The Meter selection is accomplished via S15, S16, S17. These switches provide a contact closure to ground which fires inverting Schmitt trigger A96F, A112A, A112B. This in turn sets or resets A110A, A110B or A111A. The output then illuminates the corresponding meter LED indication as well as selecting the appropriate meter drive circuit via A108.

Led indications on IOT Logic 3913 466 78090

Internal interlock H1	
Off	H9
Black heat	H10
Standby	H11
Transmit	H12
Remote/local	H13
Thyratron ready	H14
HV cct breaker on	H15
HV 2nd Step cont.	H16
Lockout	H17
Supply present	H2A
Internal I/L	H2C
Cavity air normal	H2E
B-Heaters OK	H2G
Bias volts OK	H2I
ION pump OK	H3A
IPA air normal	H3C
Collector cooling OK	H3E
External I/L	H3G
Full heaters OK	H3I
Focus OK	H4A
Delay over	H4C
Ready	H4E
HV normal	H4G
IPA PSU OK	H4I
IPA power OK	H5A
Visual power OK	H5C
Spare 1	H5E
Cavity arc 1	H6A
Cavity arc 2	H6C
Motor overload	H6G
Cabinet over temp	H6E
HV 2nd step fail	H6I
Collector over current	H7A
Tube over temperature	H7C
ION pump over current	H7E
Bias over current	H7G
Thyratron fired	H7I
Refl vision over power	H8A
Body current high	H8C
Spare 2	H8E

4.14.3 IOT logic link positions

Link settings.

X21	*a-b Cavity arc 2. 3 shot
	b-c Cavity arc 2. single shot
X25	*a-b Cavity arc 1. 3 shot
	b-c Cavity arc 1. single shot
X22	*a-b Reflected power. 3 shot
	b-c Reflected power. single shot
X23	*a-b Reject power. 3 shot
	b-c Reject power. single shot
X24	*a-b Ion Current. 3 shot
	b-c Ion Current. Single
X20	a-b 4 shot
	*b-c 3 shot
X10	*a-b link for lockout to off
	b-c link for any other
X11	a-b link for lockout to black heat
	*b-c link for any other
X12	a-b link for lockout to standby
	*b-c link for any other
X13	a-b link for all controls linked
	*b-c link for controls separate
X3	*a-b link for Go home not AND'ed with ready
	b-c link for Go Home to AND with ready
X4	*a-b link for Reject Power not AND'ed with ready
	b-c link for Reject Power to AND with ready
X1	a-b link for no 2 minute delay
	*b-c link for 2 minute delay from blackheat ready
X27	*a-b link for Crowbar fired 3/4 shot
	b-c link for Crowbar fired single shot
X8	a-b link for Go Home O/P latching enabled
	*b-c link for Go Home O/P latching disabled
X9	*a-b link for Reject Power O/P latching enabled
	b-c link for Reject Power O/P latching disabled
X2	a-b link for lockout O/P latching enabled
	*b-c link for lockout O/P latching disabled
X26	a-b HV 2nd step fail test
	*b-c normal operation
X14	*a-b link for O/C remote inputs
	b-c link for TTL remote inputs
X15	a-b link for 5V-12V open for 12V-24V
X16	a-b link for 5V-12V open for 12V-24V
X17	a-b link for 5V-12V open for 12V-24V
X18	a-b link for 5V-12V open for 12V-24V
X19	a-b link for 5V-12V open for 12V-24V

* = normal position

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4.15 Theory Of Operation: IOT AGC & UHF LINEARIZER 992-9881-001

The AGC and UHF linearizer performs two basic transmitter functions:

- It controls the IOT output power and provides these features:
  1. Power control range of 0 to 110%
  2. VSWR foldback.
  3. RF mute with beam off.
  4. Back porch AGC when used in analog TV
  5. Power stabilization over temperature.
- It linearizes the IOT for optimum performance and provides:
  6. Phase Compression
  7. Phase Expansion
  8. Linearity Compression
  9. Linearity Expansion.

4.15.1 Circuit Description

Refer to schem. 843-5502-001

RF input to the PWB is applied to J6 . An attenuator on the input insure a good return loss. Amp U10 makes up for losses in the input attenuator. HY1 splits the signal into two paths. One path is applied to the correction circuits, the second is applied to an RF detector(CR13). This detector output is proportional to the level of the RF input.

A second RF detector (CR18) on the output of the correction circuits is compared with the input detector in U7. As correction adjustments are made the output level of the correction circuits change. These gain changes are sensed by U7 and an error voltage is applied to a voltage controlled attenuator(CR26, 27, 29, 30).

In this manor the output level of the correction circuits remain constant regardless of the correction settings. This constant level prevents the operator from inadvertently over driving the IPA or IOT amplifier stages.

Phase expansion correction is accomplished in a quadrature corrector. HY2 splits the signal by 90 degrees. The 90 degree path is applied to an attenuator that has an attenuation level that is a function of the signal level. Pin diodes (CR16) are switched on when the RF level exceeds a certain threshold. This threshold is set by a potentiometer (R1). A second pin diode (CR19) is used to control the amount of attenuation. This diode has an RF resistance which is proportional the DC current thru it. This DC current is controlled by a potentiometer (R2) and is called the slope control.

The two quadrature paths are combined in a resistive combiner (R116, 131 and 154). An amplifier (U12) compensates for the losses in the phase correction circuit. The phase compression circuit works in a similar manor as the expansion circuit. The only difference is that the attenuator reduces attenuation when the PIN diodes switch on.

The linearity expansion circuit uses the same attenuator design as that use in the phase expand. Since there is no quadrature path all the correction is applied to the linearity of the signal.

The linearitircuit uses the same attenuator design as that use in the phase compression. Since there is no quadrature path all the correction is applied to the linearity of the signal.

The correctors can be easily bypassed via a single switch (S1). This switch forces the bias voltage on all the switching PIN diodes to rise to the supply rail. Since the peak RF level never exceeds they supply rail no correction can be performed.

After phase and linearity correction are performed a second voltage controlled attenuator (CR22, 25, 28) is used to control the RF output level from the PWB. The voltage that controls this attenuator is derived from the power control input, the VSWR input, the Mute command and the voltage derived from the transmitter output sample detector.

A summing circuit (U17) takes the power control input and subtracts any VSWR input. This difference is routed thru a mute switch (Q5) and applied to a comparator (U1) as a power reference. The transmitter sample is compared to the power reference and the RF attenuator is driven to maintain a constant output power from the transmitter.

To prevent transmitter over drive conditions the total output power from the PWB is limited to a safe level. This level is set by control (R11) and is called the AGC limit. This limit level is set so that the maximum drive to the IPA and IOT prevents transmitter powers in excess of 110% yet allows the AGC to operate over the temperature range.

A temperature compensated RF detector (CR11, 9 and U8) is used to convert the RF sample of the transmitter to a DC voltage. In analog transmitters this DC voltage follows the video envelope and is sampled at back porch in a sample and hold circuit (Q2 and C30). The back porch sample is applied to J4 from the exciter and is timed to match the detected envelope by a dual monostable (U6)

In DTV transmitters no sample is provided by the exciter. In this case the timing circuit detects the lack of sync pulses by CR12. With no sync pulse present Q3 turns on the sample and hold circuit. The DTV signal is random in nature and the RF detector outputs a DC voltage proportional to the RMS level of the DTV signal.

Power control from the controller ranges from 2.5 to 5 V. It is level shifted to 0 to 5V in U17.

A VSWR input from the controller is proportional to the reflected power of the transmitter. The transmitter is capable of operating into a fixed VSWR before foldback needs to be activated. U18 and Q6 monitor the VSWR input and outputs a linear voltage only when the VSWR reaches a specific trip point set by the voltage divider of R200 and 201. When the VSWR trip point is reached the VSWR voltage is subtracted from the power reference in U17. Simultaneously comparator U18 outputs a VSWR Active signal to the front panel LED.

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4.16 Theory Of Operation: Feed Forward Correction

For superior efficiency, the IPA module is operated in class A/B operation. This is particularly important for high power amplification. Class A/B operation can result in distortions that can be more difficult to linearize. Feed Forward is utilized to correct for these non-linearities. The result is a class A/B IPA with a performance that far exceeds that of a class A amplifier of equivalent power capability.

Feed forward correction provides an error signal that exactly represents distortions created by a nonlinear amplifier. The error signal is then added back to the desired main signal in "anti-phase," cancelling the distortions originally produced.

Refer to schematic drawing 839-8121-820

4.16.1 Error Signal Path

A linear class A drive sample is taken from the main signal path via probe section HB3. It is then routed through a cable delay line equal to the electrical length of the main signal path. The linear sample is amplified via Reference Amp AM2 then combined with the non linear IPA output sample in a 3 dB coupler. At the coupler input the two signals are adjusted for equal amplitude. The coupler input phase (Phase Adjust 1) is then adjusted so that the carriers cancel out, leaving only the distortion products.

The coupler output, (difference or error signal), is then applied through Phase Adjust 2 into a 20 watt class A variable gain block AM1. This module allows the gain/phase adjustment of the error signal prior to the 20 Watt Error Amplifier input.

The 20 Watt Error Amplifier outputs the gain /phase adjusted difference signal to the 6 dB coupler which in turn combines the nonlinear IPA output with the anti-phase difference/error signal thus cancelling the distortions created by the IPA. The output is then fed through a probe section U1 for IPA metering and a high power circulator C1. C1 isolates impedance mismatches between the IPA and the double slugged tuner to the IOT drive input connection.

The IPA will now appear transparent to the precorrections for the linearization of the IOT.

WARNING: Disconnect primary power prior to servicing.

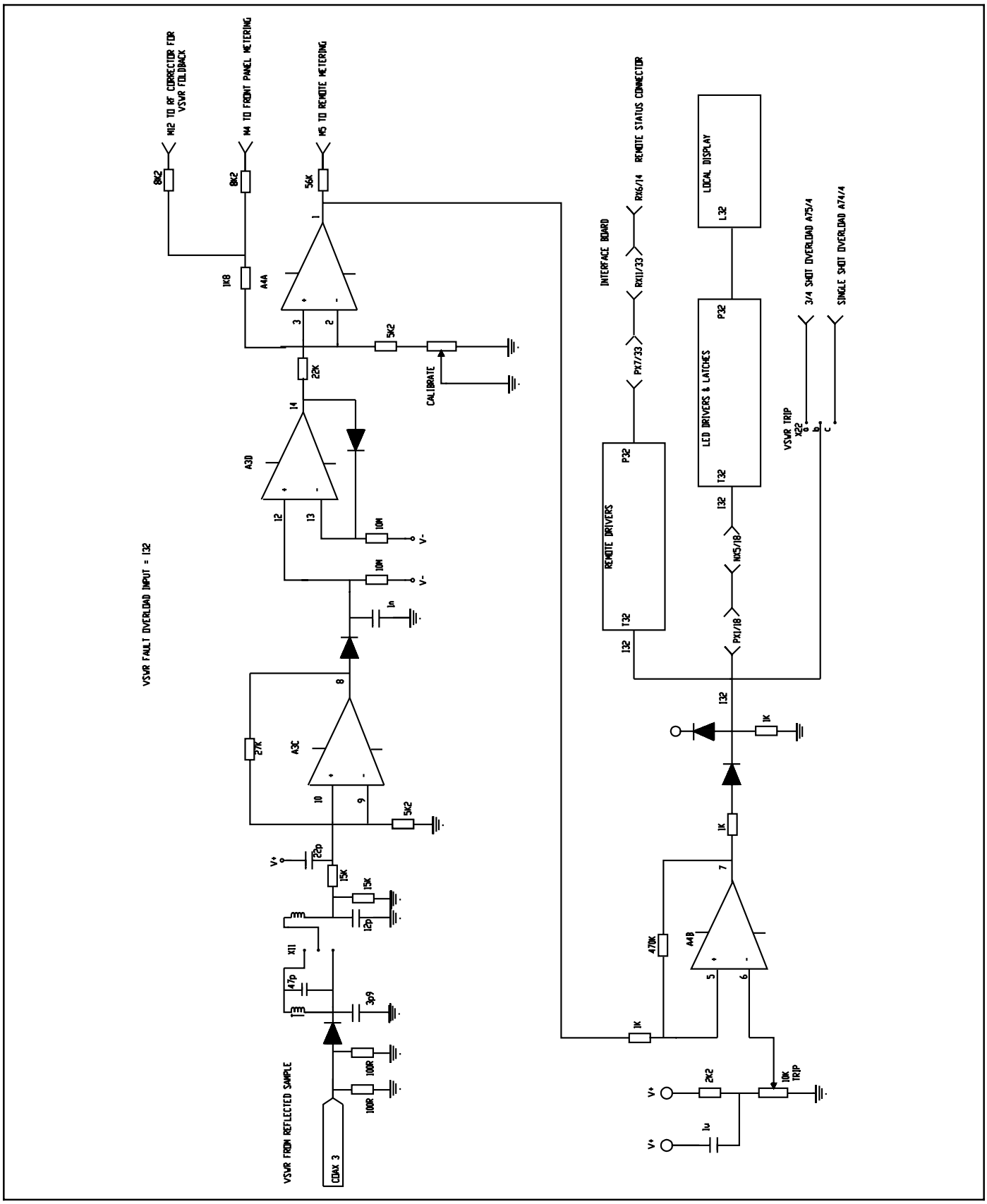


Figure 4-2. VSWR Fault Overload Input

WARNING: Disconnect primary power prior to servicing.

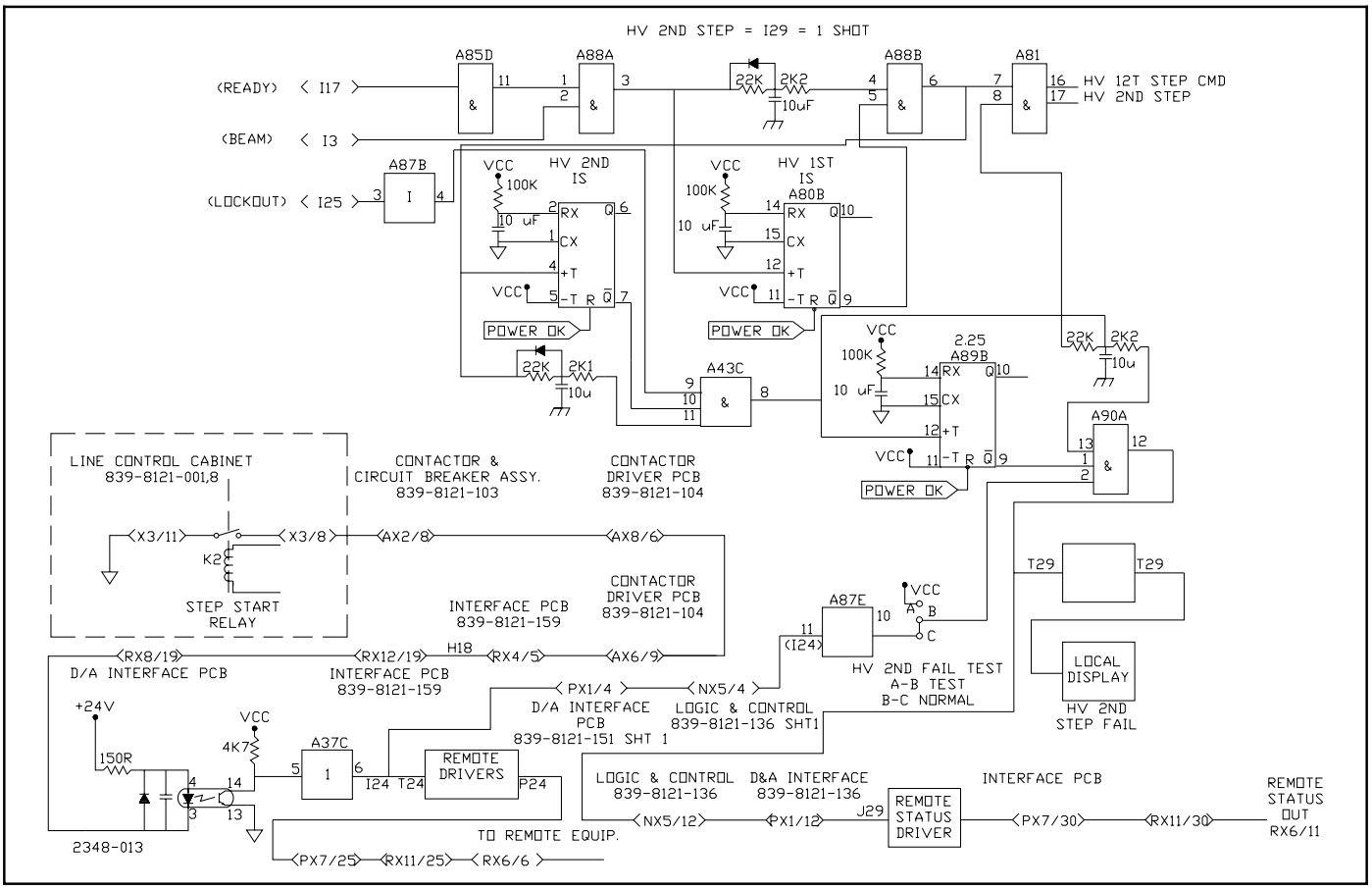


Figure 4-3. HV 2nd Step

WARNING: Disconnect primary power prior to servicing.

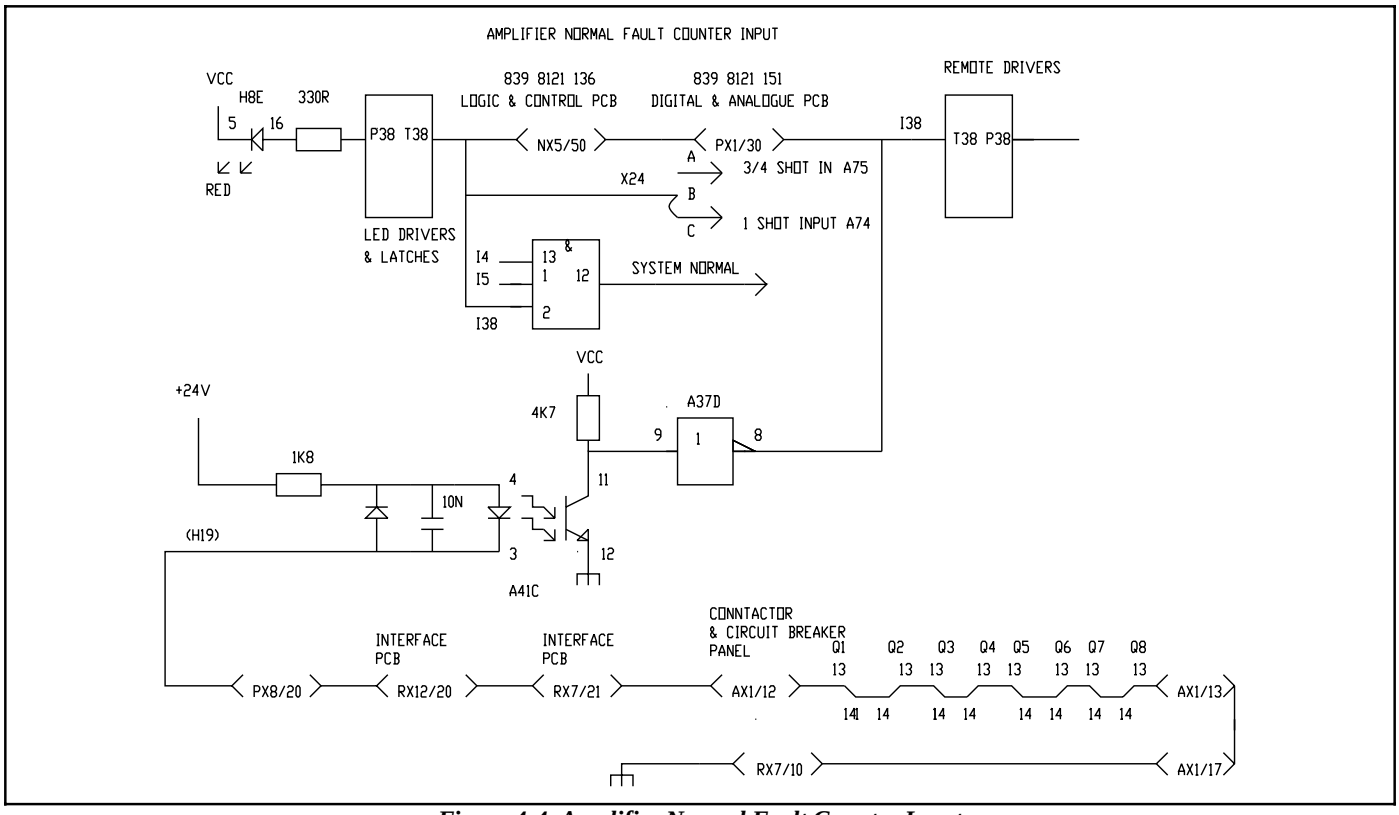


Figure 4-4. Amplifier Normal Fault Counter Input

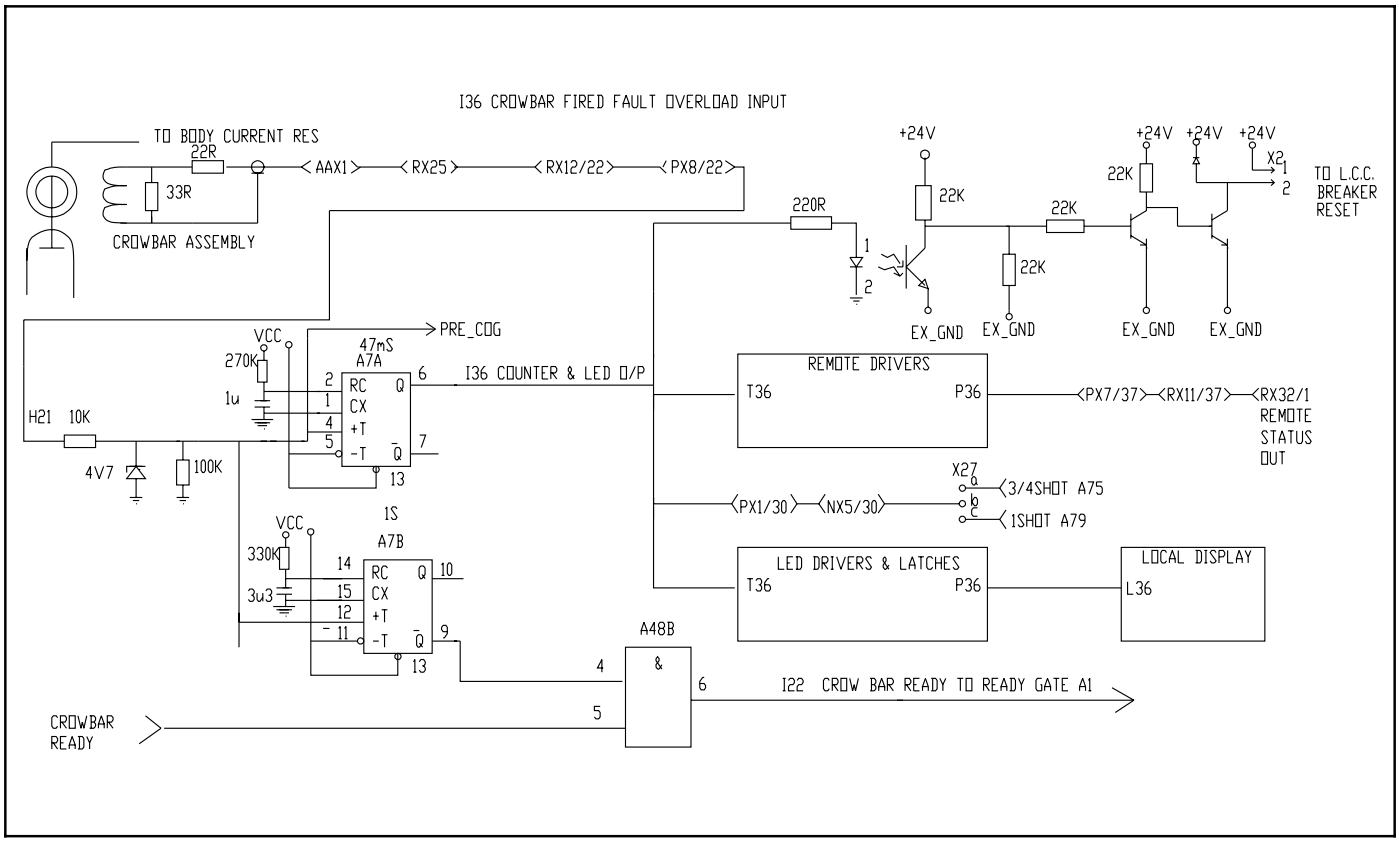


Figure 4-5. Crowbar Fired Fault Overload Input

WARNING: Disconnect primary power prior to servicing.

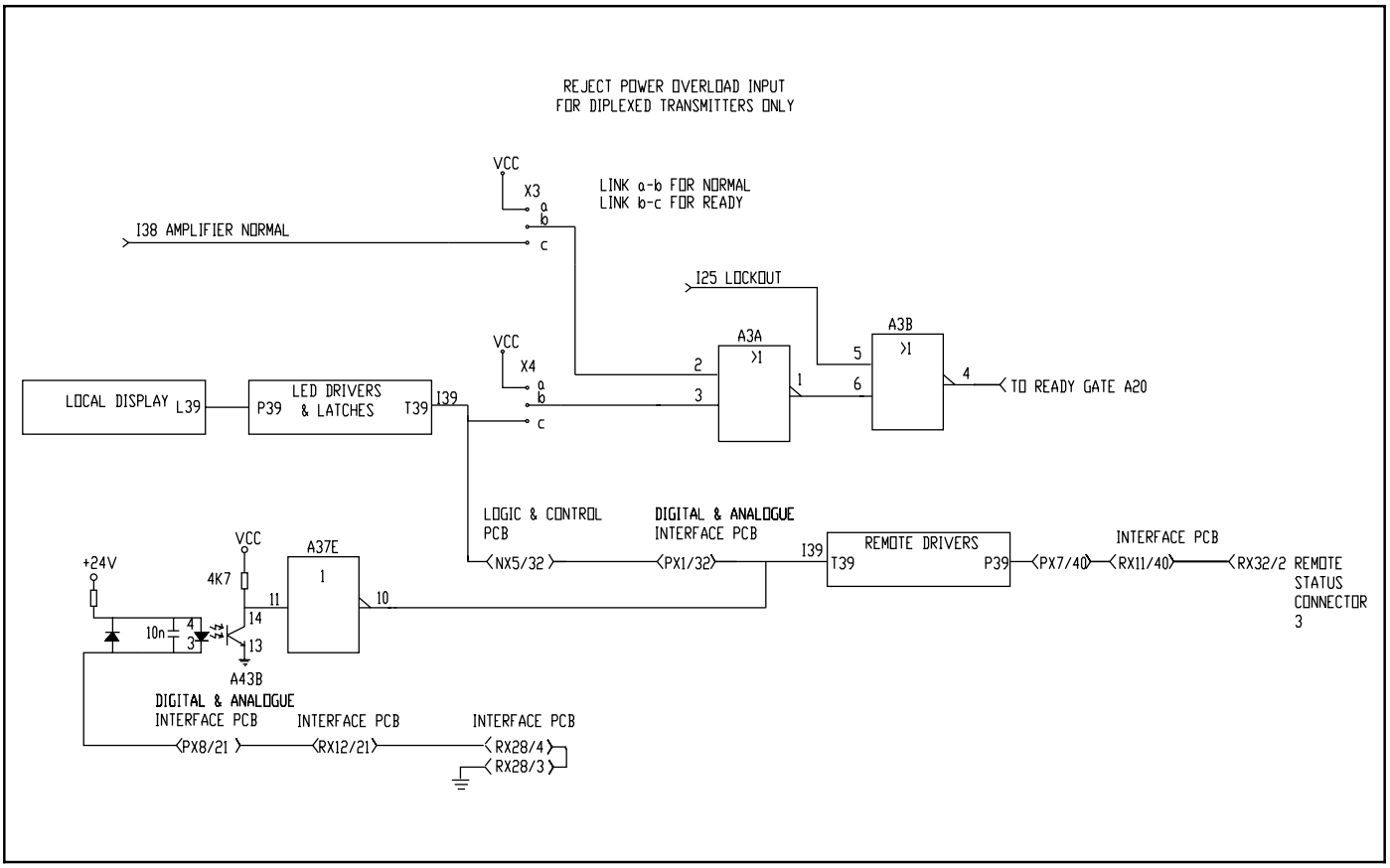


Figure 4-6. Reject Power Overload Input

WARNING: Disconnect primary power prior to servicing.

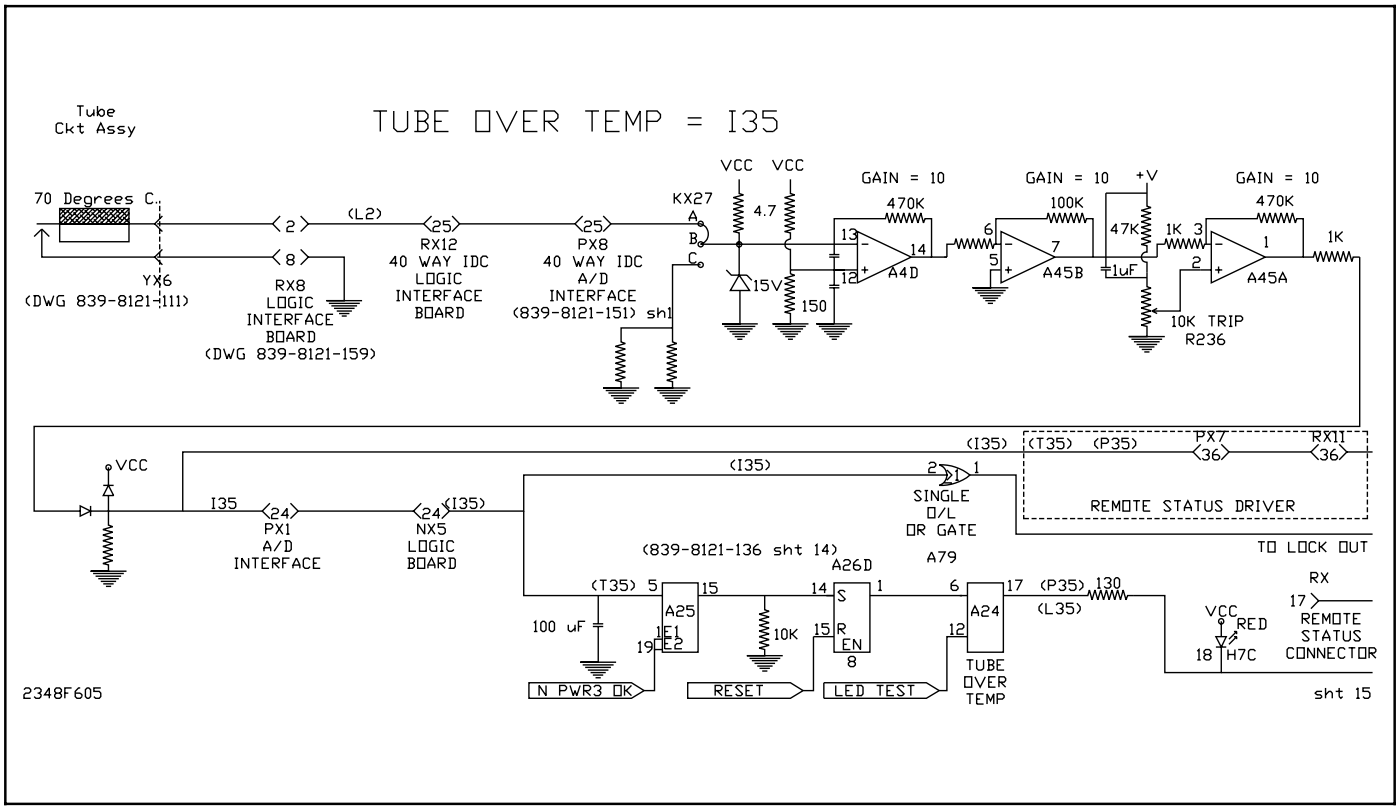


Figure 4-7. Tube Over Temperature Fault Circuit

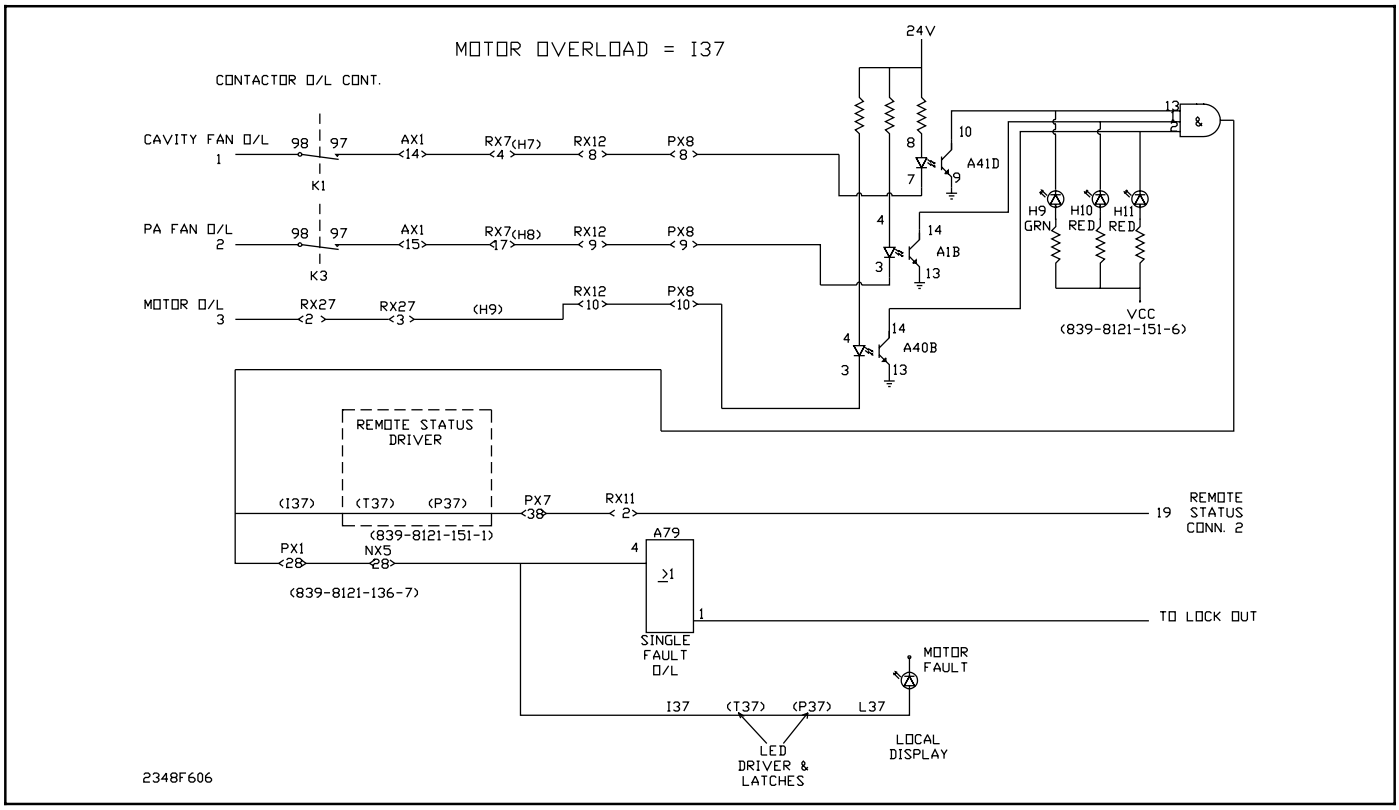


Figure 4-8. Motor Overload Fault Circuit

WARNING: Disconnect primary power prior to servicing.

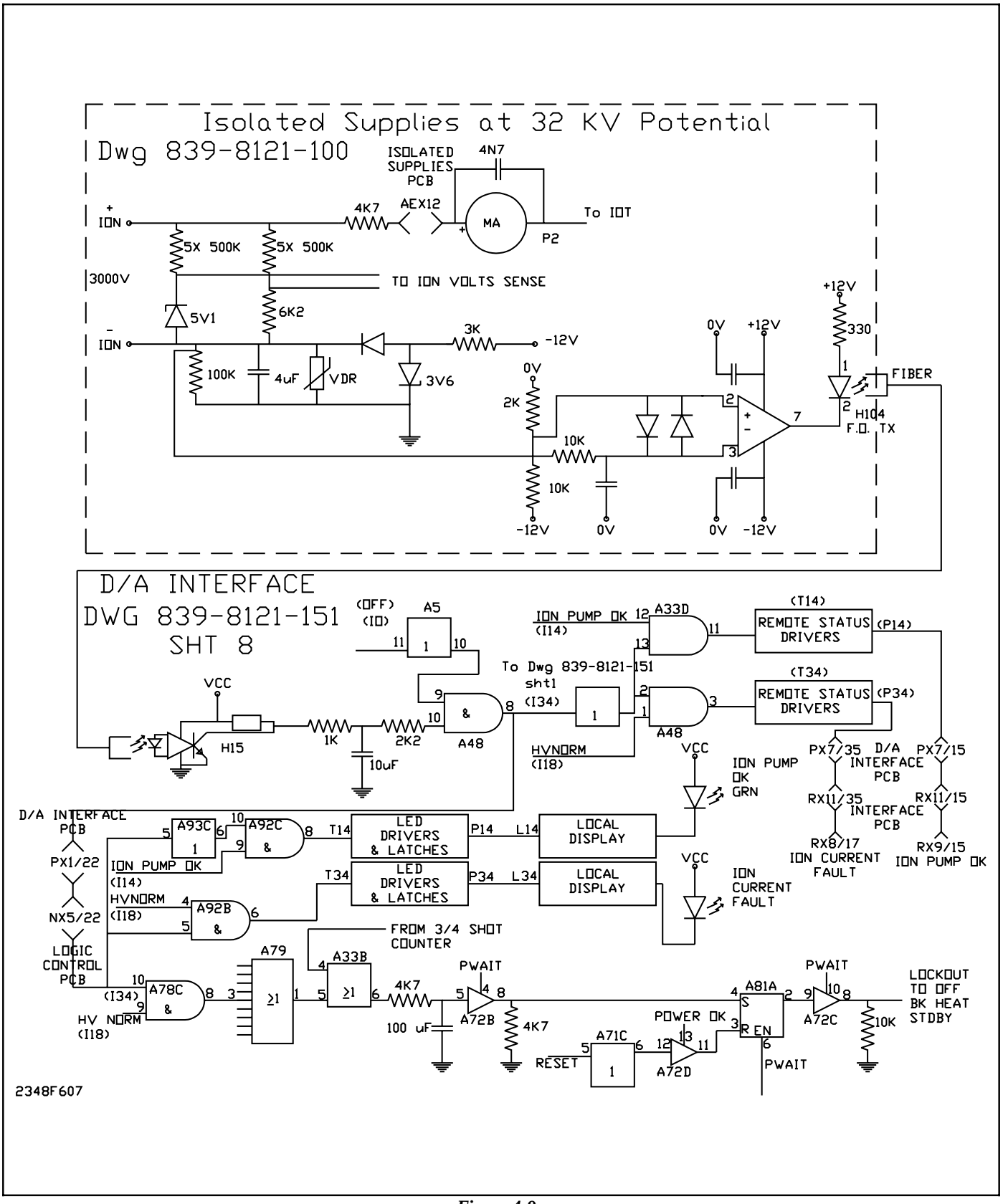


Figure 4-9.
Fault Counter Inputs Ion Current Overload Circuit

WARNING: Disconnect primary power prior to servicing.

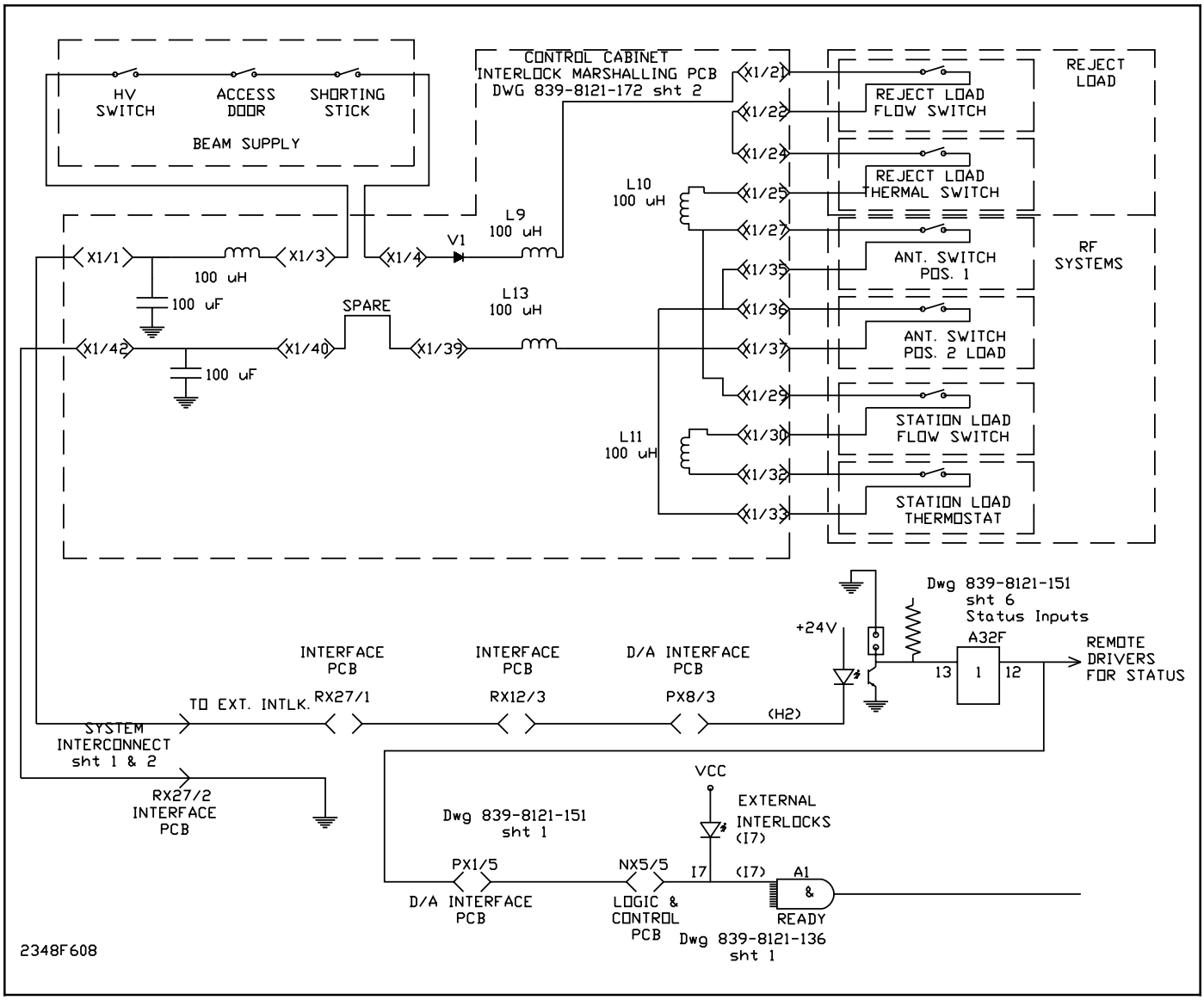


Figure 4-10. External Interlock Circuit

WARNING: Disconnect primary power prior to servicing.

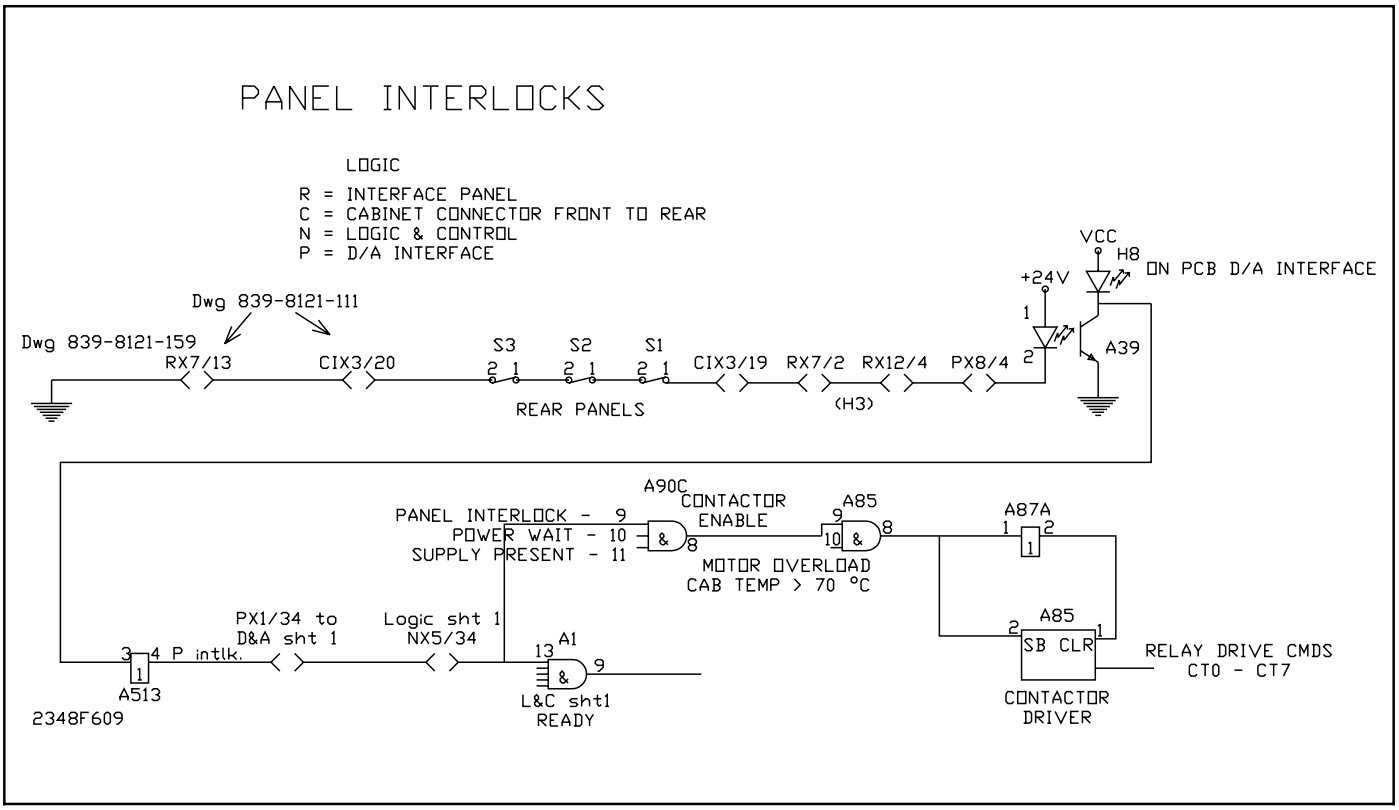


Figure 4-11. Rear Door Panel Interlock Circuit

Figure 4-12.
Logic & Control Interconnect to Contactor Driver PCB

WARNING: Disconnect primary power prior to servicing.

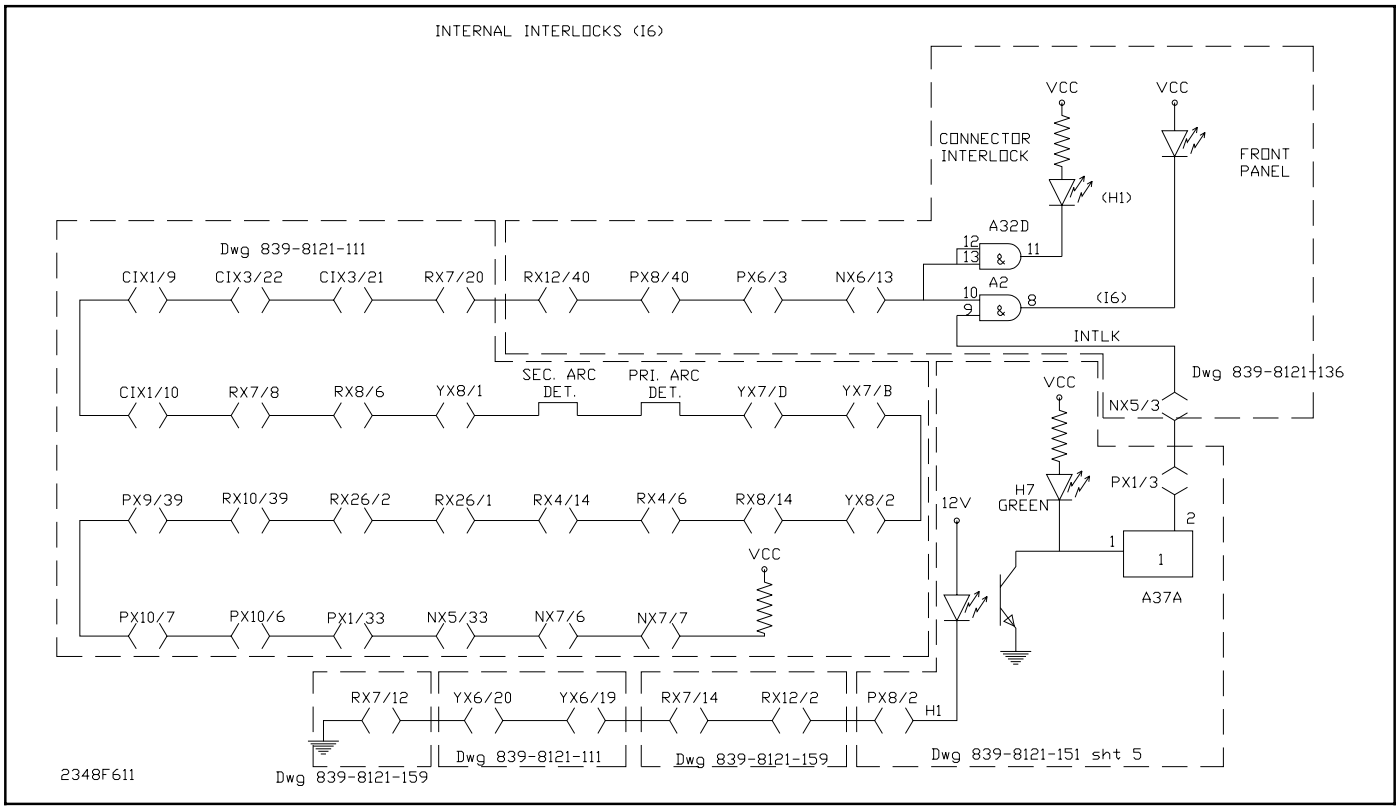


Figure 4-13. Internal Interlock Circuit

WARNING: Disconnect primary power prior to servicing.

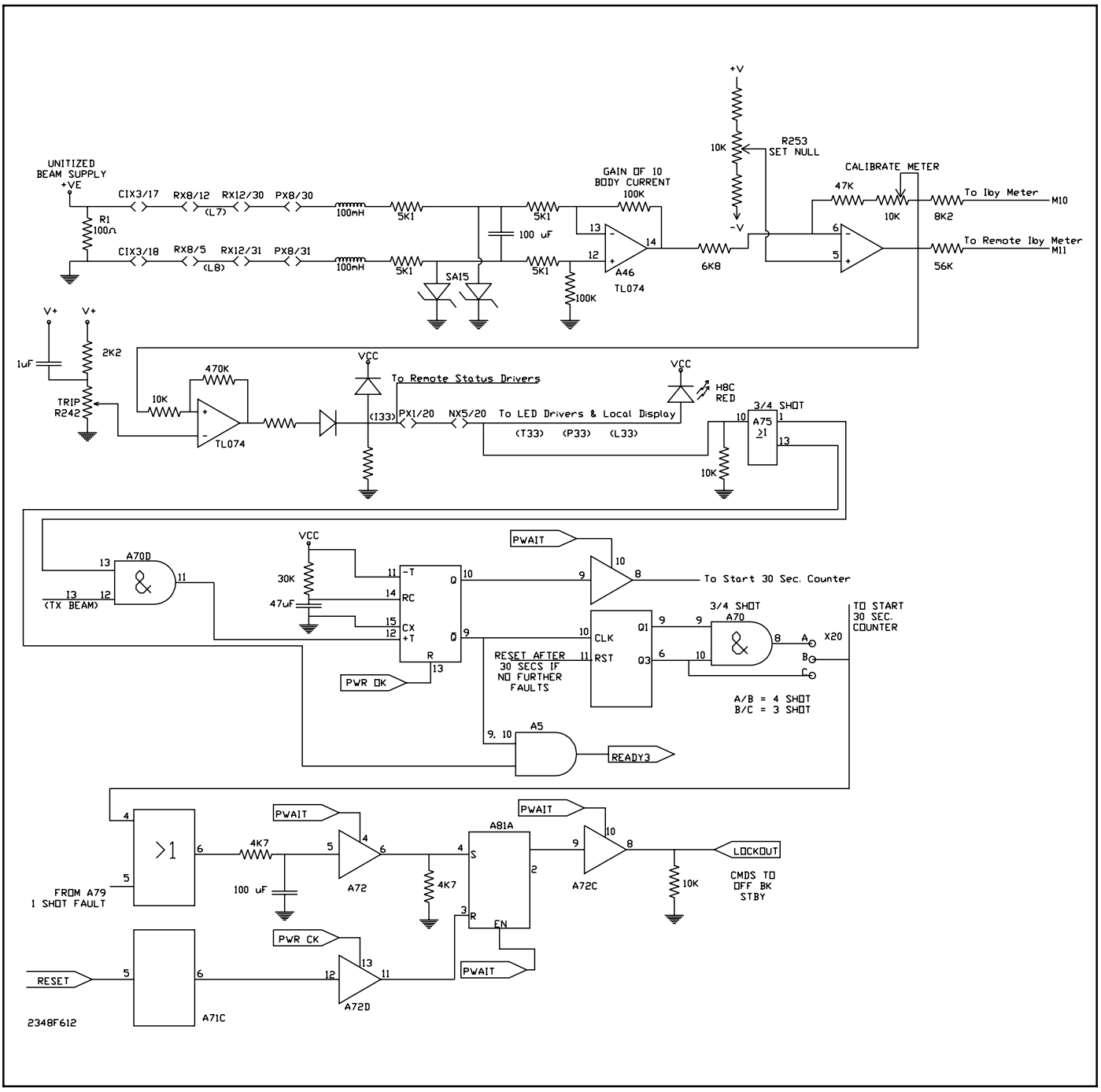


Figure 4-14.
Body Current Metering and Overload Input

WARNING: Disconnect primary power prior to servicing.

5.1 General Transmitter Maintenance Information

This section contains maintenance instructions for the **Sigma® CD series of UHF Television Transmitters. Routine maintenance and the recommended maintenance schedule is given. Test equipment needed for the effective accomplishment of maintenance is listed and test/adjustment procedures are given. It should be kept in mind that the equipment type involved and its use, brings about a maintenance function that closely allies operation, testing, and troubleshooting. In many instances, one cannot be accomplished without the other. In view of this, the procedures contained in this section should be looked upon as the basic guidelines for continued reliable operation but do not in all cases constitute the sole manner of proper maintenance.**

5.2 Recommended Test Equipment

See Table 5-1.

5.3 Equipment Cleaning

Cleaning the external surfaces of the transmitter can be done at any time without contacting dangerous voltages. A soft cloth and household type spray detergent should be used to remove fingerprints and dirt smudges from the painted surfaces. Do not spray cleanser into cracks, drawers or other crevices on the exterior of the transmitter or saturate hinges or latch assemblies. It is recommended that the cleaning cloth be sprayed and the equipment carefully wiped clean. For transparent meter faces a static free glass cleaner should be used to prevent changing meter calibration due to generated static potential.

5.4 Scheduled Maintenance

The maintenance schedule was established based on 18 operating hours per day. The schedule should vary proportionally, especially on mechanical equipment, if the daily use is other than 18 hours. Inspection of the equipment should be performed at an interval no greater than that indicated in the schedule.

Table 5-1. Recommended Test Equipment

8VSB Demodulator
Tektronics
Vector Signal Analyzer
Hewlett Packard Model 89441 or Tektronics RFA300
Network Analyzer
Hewlett Packard Model HP 8712C or HP 8753
Spectrum Analyzers
Hewlett Packard Spectrum Analyzer Model 8591E with Tracking Generator
Tektronix Spectrum Analyzer Model 2712, 2792, 2794, or 2750 with Tracking Generator
Power Measurement
HP 8481H Power Sensor or equivalent 300 MWatts
HP 435B Power Meter/2 8482H Sensor 3 Watts
Frequency Measuring Equipment
Hewlet Packard-5315A, 5342 or Tektronix DC 508A
Miscellaneous Test Equipment
400MHz Dual Trace Scope
Booton RF Voltmeter with 50 Ohm adapter
Polaroid Oscilloscope Camera DS34W/613656 Hood
Bird Model 43 Wattmeter with 1W to 1kW elements
RF Bridge, Eagle RLB-150, 700-1289-000 Narda Coupler, 620-0457-000
UHF RF Notch Filter, Eagle Model TNF-200 484-0300-000
0-6A Current Variable Power Supply
Quantity 2 or Dual Output Voltage Variable 0-5V Power Supply. Maximum current needed is 150uA
Hipotronics 860PL High Pot Unit
EEV 4260A Tube Gas Tester
Fluke Model 87 Digital Multimeter w/80I-400 current probe, C81 Holster C25 Case

Adapters and Connectors Kit 994-8511-002	
3-1/8 inch 4-1/16 inch adaptor	620-2395-000 Myat
3-1/8 inch 4-1/16 inch adaptor	620-1928-000 Dielectric
3-1/8 inch 6-1/8 inch adaptor	620-2297-000 Myat
3-1/8 inch to type “N” adapter	620-2859-000

WARNING: Disconnect primary power prior to servicing.

5.4.1 Weekly Maintenance

5.4.1.1 Cooling System

a. Water System Leaks. Check the water system for leaks especially around the water connections to the IOT. Also check closely any water pipe joints and connections that may be located above the transmitter cabinets. All valves should be checked for leakage.

b. Glycol system leaks. By its nature, glycol has the ability to leak through a hole that water may not. Closely inspect the cooling systems for leaks including the piping to the outside cooling fans and pump module. With the pumps shut off, remove the side panels of the pump module and look for evidence of leaks on the floor of the pump module.

5.4.1.2 Electrical Performance

It is recommended that the following be checked and adjusted only if out of specification. See system test/adjustment for details.

a. Heater voltage
b. Bias Voltage
c. Meters on Amplifier cabinets, IPA diagnostics, and Control Cabinet
d. Amplitude response
e. Linearity
f. Envelope delay
g. Error Vector Magnitude
h. Bit Error Rate
i. Intermod product suppression
j. Overload system. If not on air, check by pushing one of the Arc To Test buttons to see that Beam is removed. Do Not perform this test during broadcast day as transmitter will be removed from operation.

5.4.2 Monthly Maintenance

a. Check the pumps for excessive or unusual noises. Check for leaks around the pump seals.

b. Check chiller fans for operation utilizing test switch on the coil control panel. Noting any excessive noise, indicating possible bearing failure. (Make sure power is disconnected prior to accessing motors or fans.)

c. Clean the pump strainer screens located on the pump intake (first isolate strainers utilizing gate valves.)

d. Remove and replace the 2 filter media on the amplifier cabinet rear doors. Part number 917 2336 033.

e. Check and/or replace the amp cabinet cavity blower filter on an as needed basis, Part number 448-0986-000.

5.4.2.1 Electrical Performance

a. Check the carrier frequency and adjust if necessary.

b. Check the performance of the coolant flow interlocks. Operation of these interlocks will remove the transmitter from air.

5.4.2.2 Transmitter Room

Clean any filtration equipment associated with maintaining the transmitter room temperature and cleanliness.

5.4.3 Biannual Maintenance

5.4.3.1 Heat Exchanger

a. Inspect and clean the fins of the outside fan unit. Clean fins of all debris that may inhibit air flow. This can be done with compressed air or a commercial coil cleaner. Check for bent or damaged coil fins and repair as necessary.

b. All fan motors in the outside fan units have sealed bearings that do not require periodic lubrication, however some fan unit models have bearings equipped with pillow blocks that support the fan shaft. Check for the presence of pillow blocks on your unit and see if a lubrication fitting is installed. If so, these bearings require lubrication on a biannual basis.

c. Some models of pumps also have grease fittings. Check for the presence of grease fittings and inject grease as needed.

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

5.4.3.2 IOT Inspection

Remove IOT and Magnet Assembly from amplifier cabinet using the IOT Removal procedure later in this section, but do not remove the tube. Remove the air duct input to the primary cavity, as well as the dome on the secondary output cavity. Use a flashlight to inspect the IOT ceramic. Look for dirt on the ceramic, especially on the ceramic surface opposite the air inlet duct. Next check the input cavity for cleanliness and any evidence of arcing. The amount of dirt will determine the cycle of cleaning.

5.4.3.3 Interior Transmitter Cleaning

Cleaning the inside of the Transmitter should be done using a vacuum cleaner and a clean soft paint brush. Ensure that all power to the Transmitter is Off and all high voltage circuits have been discharged. Be careful to not dislodge or damage wiring, components, or terminals. The soft bristle paint brush is recommended for dislodging dust.

NOTE

Depending on the air quality in the transmitter room, interior transmitter cleaning may be required more often.

5.4.3.4 Electrical Performance

a. Check power meter calibration.

b. Check each interlock and overload for proper operation. See Section II.

c. Check collector current meter calibration. See Section II.

d. Check body current calibration (EEV IOT only). See Section II.

WARNING: Disconnect primary power prior to servicing.

5.4.3.5 Beam Power Supply

WARNING

ENSURE THAT ALL POWER IS REMOVED FROM THE TRANSMITTER AND HIGH VOLTAGE POWER SUPPLY BEFORE PERFORMING THE FOLLOWING STEPS. ALWAYS USE A GROUNDING STICK TO ENSURE THAT THERE ARE NO RESIDUAL VOLTAGES PRESENT.

a. Check for tightness of all wire connections.
b. Check the lead dress of the beam supply wiring. Wires should not touch any sharp edges nor should any wire with low voltage insulation be allowed any closer to any high voltage terminal than 6 inches.
c. Check the feed through bushings for oil leaks.
d. Visually inspect the bleeder resistors and check with an ohmmeter.
e. Wipe off the high voltage insulators on the beam supply and filter capacitors with a clean dry cloth.

5.4.4 Annual Maintenance

5.4.4.1 IOT/Thyratron Ceramic Cleaning

Cleaning of tube ceramics is only necessary if they are dirty. Dirt and foreign matter on the surface of the ceramic may cause local overheating or arcing and can lead to tube failure.

a. Remove IOT and magnet assembly from amplifier cabinet using the IOT Removal Procedure later in this section, but do not remove the tube. Note coupling angles on output loop and primary to secondary loop so they may be replaced in **exactly** the same position.
b. Remove input cavity utilizing chain hoist (EEV only).
c. Remove secondary output cavity and unbolt primary cavity halves to gain access to the IOT ceramics.
d. Dust may be removed from the ceramic parts with a clean soft cloth or brush. More persistent spots may be removed with rubbing alcohol applied to a clean cloth and then cleaning the ceramic.

If arc marks or other contamination remain on the ceramic that rubbing alcohol will not remove, refer to the tube manufacturer's application data sheet that covers this subject.

5.4.4.2 Cavity Inspection

a. The cavities should be checked and cleaned any time they are removed from the tube. The inside of the cavity should be cleaned with a soft clean dry cloth. A dry, soft brush is recommended to clean the contact fingers. More persistent dust may be removed with rubbing alcohol. Do not use contact sprays.
b. The contact areas of the spring contacts inside and outside the cavity should be inspected for burn marks. If small burn marks are noticed, they should be carefully cleaned off using Scotch Brite pads. Do not use crocus cloth or sandpaper.
c. Damaged contact springs, particularly those that have been deformed, must be removed.

5.4.4.3 Beam Supply

a. Visually inspect the oil in the power supply and look for cloudy or contaminated oil.
b. Remove a small sample of oil from the bottom of the beam supply at the valve on the oil tank and have it checked for water contamination.

5.4.4.4 Glycol System

From the system drain valve located on the suction return lines to the pumps, take a sample of glycol for evaluation of the inhibitors and system acidity.

5.4.4.5 Fiberglass Insulators (G-10)

The G-10 fiberglass components, such as the Isolation meter panel and the shorting switch assembly, should be cleaned with Isopropyl alcohol and a clean soft rag to prevent flash over. Depending on air quality, this may need to be done more often, but should be done at least once a year.

5.5 Water Flow Rate Calibration

a. Adjust the collector and body circuit supply valves for the appropriate rates as indicated on the cabinet flow meters. Adjust the flow meter interlock.
b. MINIMUM Flow rates (Glycol) should be as follows:

IOTD270	
Collector	8.5 GPM (32 LPM)
Body	2.0 GPM (8 LPM)
IOTD2100	
Collector	12 GPM (45 LPM)
Body	2.0 GPM (8 LPM)

c. Observe the flow meters and check coolant flow to the Reject and test loads in the RF system.

5.6 IPA and Cavity Air Flow

a. Using a Dwyer manometer measure the air flow supplied to the IPA and IOT Cavity plenums. The trip points may be set by adjusting the sensitivity of the air pressure switches for the appropriate air system.
b. MINIMUM Air flow rate should be as follows:

60 Hz Systems	
IPA Air Plenum	0.9" H_2O (2.29 Cm)
IOT Cavity Air Manifold	6.0" H_2O (15.24 Cm)
50 Hz Systems	
IPA Air Plenum	0.63" H_2O (1.6 Cm)
IOT Cavity Air Manifold	4.0" H_2O (10.2 Cm)

5.7 Thyratron Removal and Replacement

5.7.1 Thyratron Tube Installation

Thyratron installation should be accomplished as per prints 839-8121-771 and 843-5496-039. Also, refer to the following

Front/Rear Cab Analog/Digital (PA cabinet interconnection) schematics: 843-5496-048 for EEV tubes, or 843-5496-071 for CPI tubes.

Connections to the thyratron are as follows:

a. Mount the tube on the three 2 inch long hex standoffs.
b. Connect the red and yellow leads (reservoir /heater) leads to (H/2) X1 terminal on the FDU/thyratron interface assembly.
c. Attach S1-1 thermostat and capacitors C2, C3 and C4 to the cathode ring with 1/4-20 bolt.
d. Connect R5 470R 12 watt resistor to the grading grid.
e. Connect lead labeled G1, capacitor C3 and thermostat lead S1-2 to grid 1.
f. Connect lead labeled G2 and capacitor C4 to grid 2.
g. Locate lead from the isolated platform and attach to the cathode ring.
h. Locate lead labeled anode and attach to the tube anode screw.
i. Connect BNC cable #337 between crowbar assembly AAX1 and rear cabinet jack CIX7
j. Connect the thyratron filament transformer wire 358 and wire 359 to X1 of the FDU and the isolated platform as per schematic 839-8121-745.

5.8 IOT Removal/Replacement

a. For multiple PA transmitters, set Mode controller to place the operable IOT(s) on the air.
b. Depress OFF. Wait for automatic run down until blowers and pumps are Off.
c. At Line Control Cabinet set breakers labeled BEAM POWER SUPPLY MAIN, TRANSMITTER CABINET MAIN and TRANSMITTER CABINET POWER SUPPLIES to OFF.
d. At rear of PA cabinet rotate Cabinet Isolator to 0 position and rotate the cabinet shorting switch to the "Short to Earth" (grounded) position.
e. Remove IOT RF input cable from the double slug tuner.
f. Disconnect top lid interlock connector YX9.
g. Remove front half of the cover plate on top of the input cavity assembly by removing the Allen key screws holding it in place.

WARNING

USE EARTHING WAND TO DISCHARGE IOT CONNECTIONS PRIOR TO DISCONNECTION AND TUBE REMOVAL

h. Remove Heater, Heater Cathode, Ion Pump, and Bias wires inside the assembly by first pushing them into the connector then pulling outward to release the self latching mechanism.
i. Remove three Allen key screws on the rear half of the cover plate and remove the entire junction box by grasping the flexible conduit on top.
j. Remove air supply hoses from the circuit assembly distribution manifold (plastic pipe) and RF break-away assembly.
k. Disconnect the coolant hoses (Hansen fittings).
l. Disconnect YX6 cabinet interconnect harness from the base of the circuit assembly.
m. Disconnect Focus Supply connector YX7 at top left corner of circuit assembly.
n. Disconnect earth strap from top left corner of assembly.

5.8.1 Transmission Line Breakaway

5.8.1.1 Disassembly/Assembly When Other IOTs Operating

When IOT is being replaced while another IOT in the transmitter continues to operate, a possibility of significant levels of RF energy may exist on the transmission line inner conductor of the breakaway being disassembled. Therefore, if other portions of the Transmitter continue to operate, disassemble the breakaway transmission line on the failed IOT using the following procedure:

WARNING

THE FOLLOWING PROCEDURE EXPOSES A CONDUCTOR THAT MAY CONTAIN RF VOLTAGE THAT COULD CAUSE RF BURNS TO THE SKIN. WEAR ELECTRICALLY INSULATING RUBBER GLOVES WHEN USING TOOLS THAT WILL TOUCH THE CENTER CONDUCTOR.

a. Loosen the outer sleeve over the transmission line break-away and slide it up clear of the outer conductor separation point.
b. Using a metallic tool with an insulated handle, short the inner conductor of the breakaway to the outer conductor.
c. Continue to short the inner conductor to the outer conductor. Wear electrically insulating rubber gloves. On the center conductor rotate and raise the inner conductor slip joint to free the lower half of the center conductor from the upper half.
d. To re-assemble the breakaway assembly, perform the previous procedure in reverse order using the same precautions.

5.8.1.2 Disassembly/Assembly When Other IOTs NOT Operating

a. Loosen the outer sleeve over the transmission line breakaway and slide it down clear of the outer conductor separation point.
b. On the center conductor rotate and raise the inner conductor slip joint to free the lower half of the center conductor from the upper half.

5.8.2 Tube Removal

a. Remove the two screws holding each side of trim plate at base of cabinet front.
b. Carefully roll the circuit assembly out of the cabinet.
c. For EEV tubes, move the circuit assembly into an area where you can vertically hoist the tube. This requires 10 foot minimum floor to ceiling clearance using the chain hoist supplied with the Transmitter , and a fixed lifting point capable of supporting the weight of the tube and the hoist. CPI tubes do not require a hoist.

d. Remove lower break-away assembly from the Secondary cavity by removing six bolts on the EIA 3 1/8" flange.

e. See EEV Assembly manual MA2700A and reverse the assembly procedures to extract the old tube and then install the new tube.

f. Reverse above sequence to install the circuit assembly in the transmitter cabinet. See EEV Manual that is shipped with each tube for assembly instructions.

Table 5-2 is a check list which should be followed before powering up after re-assembly.

5.8.3 IOT Replacement

Replacement of the IOT should require little or no tuning. Once the IOT is replaced, usually only a slight rocking of the response with the secondary cavity tuning is required. If the collector current, response, DTV shoulders or EVM are not within specifications, then the following "IOT Tuning" procedure will have to be done.

5.8.4 IOT Tuning

This procedure makes no assumptions about any previous tuning that may have been done on the tranmitter and therefore starts at the beginning. Do not start this procedure unless prepared to finish.

Key points to remember:

Primary	Frequency Control
Secondary	Response Tilt
Inter-cavity Coupling	Bandwidth
Output coupling	Passband sag

CAUTION

The tube can be damaged if there is high power at the tube I/P (100W) which is not being coupled efficiently to the output. (I.e. if the tube is detuned OR the BEAM is OFF). Care should be taken when performing a high power wideband sweep when there are RF filters in the transmitter output feeder.

CAUTION

NEVER APPLY DRIVE TO THE TUBE WHEN THE TRANSMITTER IS IN STANDBY.

a. Provisionally cold tune the cavities to the coarse channel tuning settings, and set the output coupling loop and interstage coupling loop to 90 degrees.

b. Remove the EEV stub tuning matching section and connect the input cavity directly to the circulator (C1X2).

c. Insert a directional coupler in the circulator ballast load path, or, if available, use the input cavity reflected power monitor socket on the left wall of the feed forward area.

d. Disconnect the input to the 40W amplifier at AM1:X1.

e. Set the Network Analyzer for a 10MHz sweep centered at mid channel, with markers at ±3MHz, output power –10dBm, Channel B Transmission.

f. Ensure that the transmitter is switched to Beam On, and that the beam volts and quiescent current are correct for the rated output power.

Table 5-2. IOT/Magnet Connection Checklist

	Cathode Heater Connection
	Heater Connection
	Ion Pump Connection
	Bias Voltage Connection
	Magnet Frame Ground Strap
	Magnet Plug Yx6
	Cable Yx7
	ARC Detectors
	Thermal Switch Collector
	Directional Coupler Coax Cables
	RF Input
	Break Away Air Supply
	Magnet Air Manifold
	Magnet Air Switch
	Coolant Inlet Hose, Outlet Hose
	Body Coolant Hoses Connected and Tightened
	Break Away Inner Conductor Tightened
	Break Away Outer Sleeve in Place and Tightened

g. Set the gain of the Linearity Boost Amplifier to minimum, remove the output connection from the Uhf Linearizer at X5 and connect the output of the Network Analyzer to the cable. Include the 10dB attenuator in the circuit.

h. Monitor the output of the IPA using the handheld diagnostic selected to a collector current position.

i. Slowly increase the output level of the Network Analyzer until the IPA just switches on, represented by a collector current of about 0.7-0.9A.

j. Tune the input cavity so that a notch appears in the circulator ballast load power at the center frequency. See Figure 5-1.

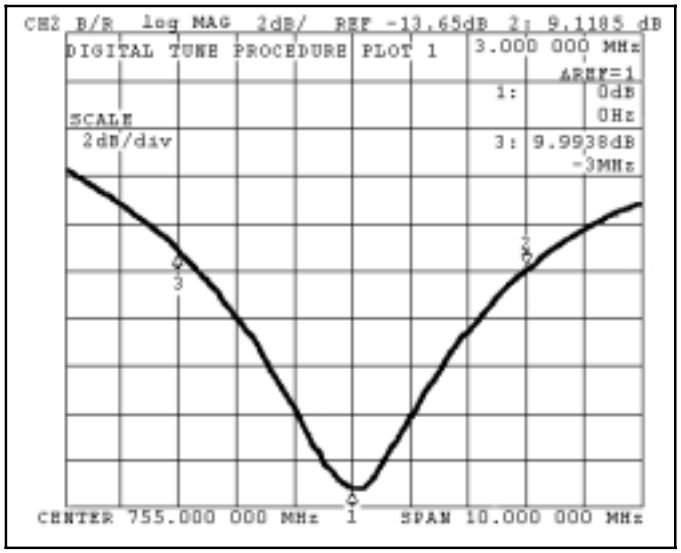


Figure 5-1. Input Cavity Tuning

WARNING: Disconnect primary power prior to servicing.

k. Transfer the Network Analyzer input to the IOT output at monitor probe WW4.

l. Adjust the primary output cavity to be at the lower frequency marker. Adjust the secondary output to be at the upper frequency marker. With these two controls and the inter-stage and output coupling controls, adjust for a band pass frequency response of approximately ±0.5dB. See Figure 5-2.

m. Move the input of the Network Analyzer back to the circulator ballast load monitor and check that the response is still as Figure 5-1.

n. Set a reference level at the ±3 MHz markers.

o. Remove power from the IPA, then disconnect the tube from the circulator and insert the stub tuner section.

p. Restore power to the IPA, and using the stub tuner and if necessary a SMALL adjustment to the input cavity tune, flatten the return loss between the markers. This level should be below the reference level set earlier. See Figure 5-3.

q. Increase the Network Analyzer Power output level until the tube collector current rises to about 1.5A.

r. Make small adjustments to the stub tuner and input cavity tuning to flatten the return loss at the higher power level. See Figure 5-4.

s. Transfer the Network Analyzer to monitor the Output response at WW4

t. Finely adjust the output cavity and coupling controls to achieve a flat bandpass response as shown in Figure 5-5.

u. Check for correct tuning by "rocking" each cavity in turn. Correct synchronous tuning is indicated when the gain at band center does not change and the response swings symmetrically about the band center.

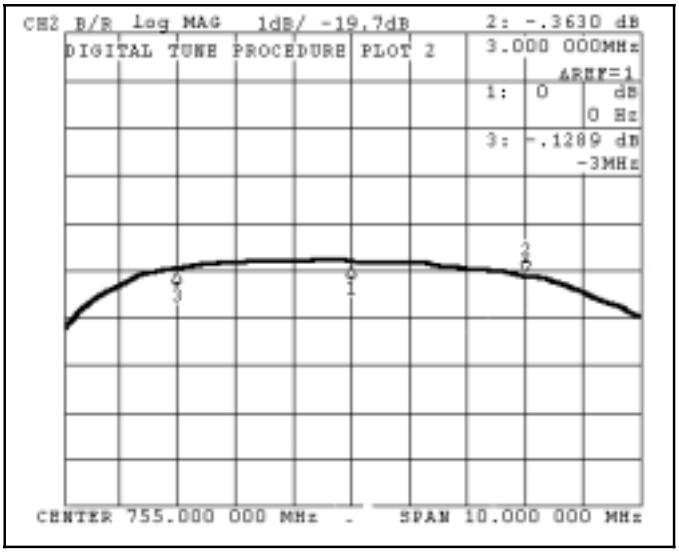


Figure 5-2. Bandpass Frequency Response

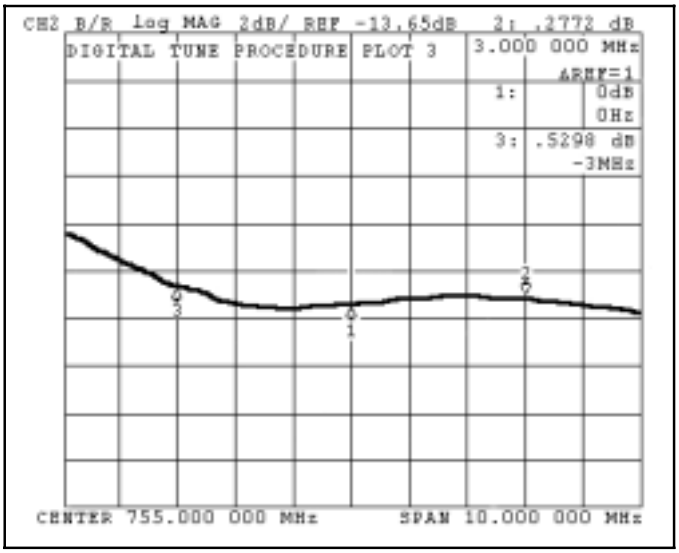


Figure 5-3. Input Cavity Tuning

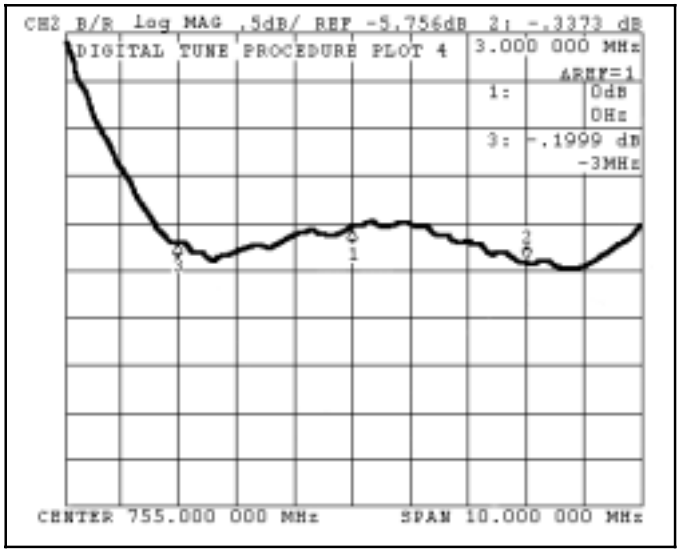


Figure 5-4. Input Cavity Return Loss (Using Stub Tuner)

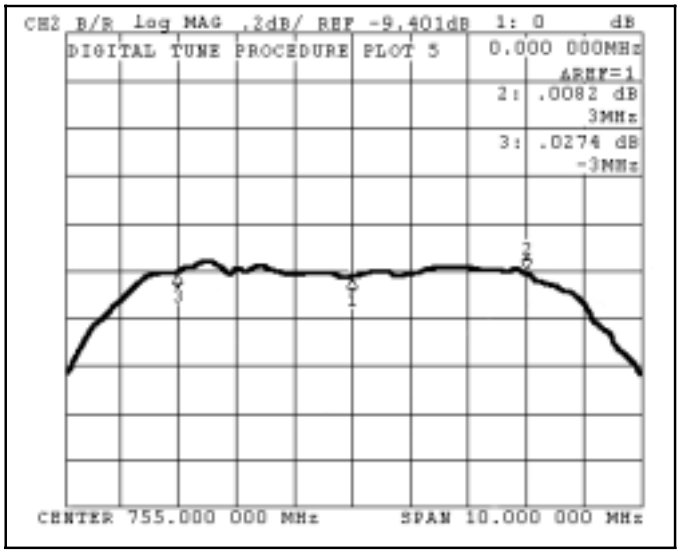


Figure 5-5. Flat Bandpass Response

WARNING: Disconnect primary power prior to servicing.

5.9 RF Linearizer Initial Setup.

a. Initial Settings
   1. Remove the UHF Linearizer input at X4.
   2. Set correction pots R1 and R8 fully CCW.
   3. Set level pots R11, R12 fully clockwise.
   4. Set JP1 1-2, JP2 2-3, JP3 2-3.
   5. Set corrector bypass switch S1 to out.

b. Mute and Level Control
   1. Ensure that there is no RF input to the Linearizer at X4.
   2. Switch the meter on the Linearizer front panel to the ALC position.
   3. With the transmitter switched to Beam on, depress the "power raise" button on the control panel. The ALC meter should read almost full scale deflection.
   4. Switch the transmitter back to Standby. The ALC meter reading should fall to zero, and the red LED on the mute relay assembly (MR) should illuminate.
   5. Switch the transmitter back to Beam on.
   6. Remove the output cable and 10dB pad from X5.
   7. Connect the exciter to the transmitter interface panel.

CAUTION

The RF input level to the RF Linearizer, should never exceed 0.4mW or damage to the linearizer could occur.

   8. Measure the RF level to the input to the Linearizer at X4. For Digital transmitters this should be 0.1mW average power. The CD-1A exciter output is usually set at approximately 250 to 300mW. If necessary fit fixed attenuators between the drive and transmitter to achieve this level. DTV shoulders should be at least 45dB down, with 50dB being nominal.
   9. Transfer the power meter to the linearizer output at X5, and connect the RF input to X4. Check that the output power is approximately 12dB greater than the input.
   10. Set R11 fully CCW. The output power should fall to less than the input level.

c. Transmitter Output Power.
   1. Ensure that Linearizer pot R11 is fully CCW, the reconnect the output lead with 10dB attenuator to X5.
   2. With the transmitter switched on to beam, slowly rotate R11 clockwise until the power starts to rise. Care must be taken when the IPA threshold is reached as the IPA output rises very suddenly.

5.10 DTV Power Metering

Slowly turn Linearizer pot R11 clockwise until the mean power at the load is approximately 0.5dB greater than the rated output power. Now turn Linearizer pot R12 CCW until the average power at the load reduces to the correct level. Adjust the output power probe WW2 until the output power meter reads 100%.

5.11 Output VSWR foldback

Connect the O/P reflected power lead from WW1 to a spare O/P forward power probe with the transmitter at full power (Power from probe should be slightly less than VSWR trip level of 20mW). Ensure the output power is reduced to a point that the VSWR meter reads 1.4 to 1.

5.12 DTV Feed Forward Setup

a. Disconnect the output from the UHF Linearizer at X5, and connect a Network Analyzer set to 10MHz sweep centered on mid channel to the cable. Include the 10dB pad in this path.

b. Slowly increase the Network Analyzer power output until the IOT tube collector current is about 1.5A.

c. Disconnect the input to the 40W amplifier at AM1:X1, and connect to the Network Analyzer.

d. Disconnect the IPA sample probe U1:X3, (Situated at the rear of the feed forward tray), and set the gain of the reference amp (AM2) to be 3dB above minimum. Take a reference on the Network Analyzer of this level.

e. Reconnect the IPA monitor probe (U1 X3), and disconnect the reference signal by removing W9 at the output of the 10dB attenuator attached to the three way splitter (SP1).

f. Adjust the IPA monitor probe (U1 X3) to achieve the same level as the reference, ±0.5dB (Care should be taken to retain the directivity of the probe).

g. Reconnect the reference signal and adjust the lower phasing trombone (PH1) and the reference amplifier gain to minimize the level shown on the Network Analyzer. See Figure 5-6.

h. Aim to get the response symmetrical about the center frequency. If it is not possible to obtain this response, add cable lengths to either the reference or probe paths until the condition is achieved.

i. Transfer the Network Analyzer to monitor the feed forward output at probe U2 X4, (at the left hand side of the feed

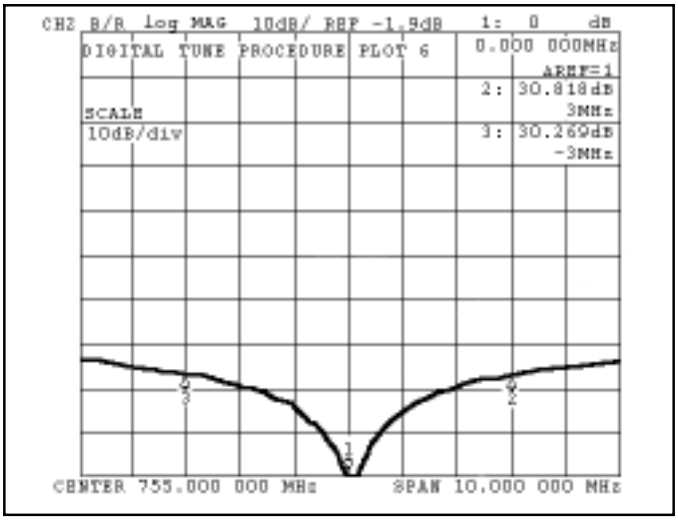


Figure 5-6.

WARNING: Disconnect primary power prior to servicing.

forward tray behind the output circulator. Measure the delay to this probe, and take a reference on the Network Analyzer.

j. Remove the IPA drive cables 39 and 1039 (for dual IPA Systems) from the splitter SP1.

k. Replace the input cable to the 40W amplifier, and set the amp gain to mid point. Set the upper phasing trombone PH2 to mid travel.

l. Now measure the delay to U2 X4 again, and compare it to the reference taken above. If necessary select a different cable length for W13 (the cable between the phasing trombone and the 40W amplifier input) to equalize the delay.

m. Reconnect cables 39 and 1039 to the splitter. Disconnect the Network Analyzer, and reconnect the cable to the output of the UHF Linearizer at X5.

n. Connect a Spectrum Analyzer to the input cable of the 40W amplifier, and check that there is a null of the wanted signal. Small adjustments of the phasing trombone PH1 and reference amplifier gain may be made if necessary.

o. Transfer the Spectrum Analyzer to the feed forward output monitor U2 X4, and display the out of band skirts either side of the wanted signal.

p. Reconnect the input to the 40W amplifier, and using the 40W amplifier gain control and the phasing trombone PH2 adjust the skirts to minimum. It should be possible to make the IPA / Feed forward combination almost transparent so that the level of the skirts are the same as those of the exciter.

q. Reconnect the Network Analyzer and check that the input and output responses are still correct. If necessary make small adjustments to the tube tuning to reproduce Figures 5-4 and 5-5.

r. Restore the Digital signal, and monitor the tube output with a Spectrum Analyzer at WW4.

s. Make small adjustments to the tube bias voltage to find the point at which the out of band skirt shoulders dip in level slightly.

t. Remove the drive and check the tube idle current – this must be between 400 and 800mA. (usually about 650mA). If the current lies outside this range the bias must be adjusted to bring it back into range, even if this is not the optimum point for the out of band signal.

u. Restore the drive and check the level of the skirt shoulders. These should be –32dB or better compared to the in band signal. If the skirts are considerably higher in level, or are very asymmetric, the output tuning of the tube will need to be adjusted to give the correct output response with a different combination of inter-stage and output coupling.

v. Now adjust the upper phasing trombone PH2 and the gain of the 40W amplifier to minimize the level of the out of band skirts.

w. Reconnect the Network Analyzer and check the tube input and output responses with the feed forward set to this condition. Make small adjustments to the cavity tuning to eliminate any response tilt caused by the feed forward adjustment.

x. Restore the digital signal and display the skirts. Switch on the UHF Linearizer correction circuits, and adjust R1&2, R3&4, R5&6, R7&8, in pairs to further reduce the skirt level.

NOTE

If necessary the Linearizer may be channelized to increase the correction available (see separate test procedure 992-9881-001)

y. Repeat this process with small adjustments to the upper phasing trombone and the gain of the 40W amplifier until there is no further improvement. The final level of the skirts should be better than –37dB down on the wanted digital signal center frequency.

z. Connect a Vector Signal Analyzer to the transmitter output and measure the transmitter EVM. This should be less than 4%. If the value is greater than this, check for a frequency tilt on the output waveform using a Spectrum Analyzer set to 1dB/div. A small tilt at full power may be compensated for by slight adjustment of the tube secondary cavity tuning, without adverse effects on the skirt level.

5.13 Power Calibration

5.13.1 Precision Directional Coupler Method Calculations

Before use, check the calibration of the output coupler.

The coupler is precisely set and the coupling ratio noted on the waveguide.

This will allow power calibration to be performed using the following procedures:

a. For DTV calibration:

b. Determine the power level expected at the output of the directional coupler.
Use the formula:

1. Power of sample = (ave power on main RF line) / $10^{(x/10)}$ or

2. Power of sample = (ave power on main RF line) / antilog(x/10) Where x = the dB ratio of the designated precision coupler which should be stenciled on the waveguide.

c. To check your result use the formula:

1. x dB = 10 log(P_1/P_2)
Where:
P_1 = the transmitter power output desired
P_2 = the calculated sample power.

d. Using an average reading RF power meter of known accuracy measure the sample port power.

WARNING: Disconnect primary power prior to servicing.

e. To convert the sample port power to the power on the main line use the formula:
Power on main line = $10^{(x/10)}$ x (Power at the sample)

5.14 Control and Support Systems: Testing and Adjustments

Settings of jumper links for the logic system operation are shown in Tables 5-3 and 5-6 near the end of this section.

5.14.1 AC Control Voltage

This procedure checks and sets the proper amplitude of the three phase 380/220 VAC that powers the transmitter control and most of the support systems.

WARNING

PROPER PROCEDURE FOR MEASURING VOLTAGES IN THE FOLLOWING STEPS REQUIRES PRIOR REMOVAL OF ALL POWER AND GROUNDING OF ALL LOCATIONS WHERE TEST LEADS ARE TO BE CONNECTED OR DISCONNECTED. THE TEST METER IS TO BE LOCATED OUTSIDE THE ENCLOSURE AND ALL DOORS OR PANELS ARE TO BE CLOSED PRIOR TO APPLYING POWER.

a. Measure the open circuit voltage of the 3 phase power line supplying power to the Line Control Cabinet. Measure phase to phase.
b. Set the taps on transformer T2 in each Line Control Cabinet to corresponding line voltage.
c. Apply power to transformer T2 by setting cabinet power CB2, control CB3 on LCC and cabinet isolator switch on the rear of the associated amplifier cabinet to 1 or On position.

WARNING

THE BEAM SUPPLY BREAKER CB1 SHOULD BE OFF.

d. Measure the voltage at terminals 15, 16, 17 of TB3 in the Line Control Cabinet with respect to terminal 18 of TB3. 220 VAC should be present.
e. Measure the voltage from terminals 15 to 16, 16 to 17, 15 to 17 on TB3. Each voltage should be 380 VAC

5.14.2 Voltage Measuring

WARNING

PROPER PROCEDURE FOR MEASURING VOLTAGES IN THE FOLLOWING STEPS REQUIRES PRIOR REMOVAL OF ALL POWER AND GROUNDING OF ALL LOCATIONS WHERE TEST LEADS ARE TO BE CONNECTED OR DISCONNECTED. THE TEST METER IS TO BE LOCATED OUTSIDE THE ENCLOSURE AND ALL DOORS OR PANELS ARE TO BE CLOSED PRIOR TO APPLYING POWER.

a. Measure the open circuit voltage of the 3 phase power line, phase to phase that powers the line control cabinet. This should be 480 VAC.
b. Select the desired output voltage using the Beam Supply selector switch located on the right of the oil tank as you are facing the access cover.

NOTE

The first time beam voltage is to be applied to a new tube or during initial transmitter checkout, the beam voltage should be set to produce the lowest beam voltage possible, then increased in steps to that voltage that yields proper performance.

5.14.3 BK Heater Voltage Adjustment

The BK Heater Voltage Adjustment is located on the contactor and circuit breaker control assembly in the front of the Amplifier Cabinet. A meter is provided inside the amplifier cabinet which can be read through the window of the panel. Set the voltage to indicate 6.0 volts. When setting the heater voltage, be sure to consider any meter calibration correction. The procedure for checking heat meter accuracy and determining a calibration correction is given in the checkout procedures (Section II).

5.14.4 Heater Voltage Adjustment

The Heater Voltage adjustment is located on center wall of the amplifier cabinet. Monitor the heater meter located inside the amplifier cabinet. Consult the factory test data sheet provided by the tube manufacturer for the recommended voltage of each individual tube.

The IOT heater transformer in the rear IOT cabinet has a tap to select the higher or lower voltage range. (This transformer is item AD of locator on back door of Transmitter, or see illustration in section VI.)

5.14.5 Magnet Current Adjustment

Magnet current adjustment is located on the Contactor and Circuit Breaker Control Panel located on the front of the amplifier cabinet. A meter is provided on the switch metering panel. Initially adjust the magnet current to the value specified on the tube data sheet (approximately 22A). Changing the magnet current has minimal effect on the IOT.

5.14.6 Heater Time Delay Adjustment

The pre-heating time during which the IOT and thyratron heaters are brought to the proper temperature for electron emission (IOT) and High Voltage Standoff (thyratron) is adjusted by switch setting in the heater 300/600 sec (5 min) timer, located on the amplifier Control Logic PCB assembly.

a. Set the beam supply CB1 to Off
b. If IOT Heaters have/had been operating press the Off button and wait five (5) minutes.
c. Depress the Standby button and begin timing the warmup as soon as the Full Heaters On indicator illuminates. If the time until the Ready light illuminates is not five minutes the timer should be adjusted.
d. Depress Off button. Open the amplifier logic panel and adjust SW5 and SW6 switch settings for the proper time delay.

WARNING: Disconnect primary power prior to servicing.

WARNING

ALL OVERLOAD/INTERLOCK ADJUSTMENTS SHOULD BE MADE WITH THE LINE CONTROL CABINET BEAM SUPPLY CIRCUIT BREAKER CB1 OFF.

5.14.7 Focus Current Interlock Adjustments

The following procedure should be performed without beam voltage present. Set the Line Control Cabinet BEAM SUPPLY POWER circuit breaker to OFF.

a. Energize the power amplifier cabinet to the FULL HEATER ON stage. The FOCUS CURRENT indicator may or may not be illuminated, however the multimeter monitoring FOCUS CURRENT should indicate focus current flowing.

b. Using the FOCUS CURRENT adjustment and the cabinet multimeter, check and record the current levels at which the upper and lower interlock settings operate. Watch the FOCUS CURRENT indicator and note when it extinguishes to make this determination. The trip points should occur at +/-2.2A from current noted on tube data sheet.

c. Remove all power from the Transmitter and set the cabinet grounding lever to the EARTHED position. Open the Control and Breaker Panel door to gain acess to focus supply shelf.

d. With both the lower and upper trip point adjustments, a clockwise (CW) adjustment of the potentiometer will raise the trip point, while a counter-clockwise (CCW) adjustment lowers the trip point. Refer to the trip point currents recorded earlier and carefully rotate the UNDER CURRENT (lower trip point) or OVER CURRENT (upper trip point) or both to change the trip point setting(s). Only a slight rotation of the potentiometer will change the trip point several amperes.

e. Re-energize the cabinet to the FULL HEATER ON level and check the trip point settings. If necessary, repeat steps c. and d. until the trip point settings are properly adjusted.

5.14.8 Collector Current/Metering Calibration & Overload Adjustments

A current source capable of producing 5 amps will be utilized. Refer to Figure 5-7. For adjustment locations refer to Tables 5-4 and 5-5.

a. Assure that the beam supply breaker CB1 on the line control cabinet is off.

b. On the amplifier cabinet rear shorting switch panel rotate the cabinet isolator switch to off (0) and engage the short to earth switch.

c. Remove the center door of the three on the rear of the amplifier cabinet under test.

d. Locate the shorting stick and discharge the isolated supplies board, the AM meter assembly and the thyratron floating deck. Leave the shorting stick attached to the thyratron floating deck.

e. Remove the (4) 7/16" nuts holding the cover over the AM module.

f. Locate the collector current meter shunt located in the upper left hand corner of the AM board. Attach the current source leads through an external Amp meter to the shunt. Ensure current source is set to off.

g. Replace the rear door ensuring the test lead remain connected.

h. Open short to earth switch and rotate cabinet isolator to the on (1) position.

i. Open the amplifier cabinet control panel and open the rear of the control panel door by loosening the two (2) captive thumb screws.

j. Locate R255 current metering null, R240 current metering calibrate, R241 current metering trip located on the digital to analog PCB.

k. Monitor the collector current meter on the switched meter panel. Rotate R255 collector current metering null to zero the meter.

l. Energize current source and adjust for 2.2 Amps using external meter. If amplifier collector current meter pegs negative, reverse the polarity of the current source.

m. Adjust R240 collector current calibrate pot to indicate 2.2 Amps on the collector current meter. This may trip the collector current overload.

n. Next, adjust the power supply and collector current trip overload R241 to illuminate the collector current overload LED when collector current reaches 2.5 Amps. This may have to be repeated several times to ensure an accurate setting. Depress the overload indicator reset to clear the overload condition.

o. Rotate the cabinet isolator to the OFF (0) position. Remove test setup and re-install covers. Return transmitter to operating condition.

5.14.9 Body Current Metering Calibration & Overload Adjustments

A current source capable of producing 100 mA will be required.

a. Select off on the amp under test.

b. Turn beam supply CB1 to off

c. Rotate cabinet isolator to off (0) position

d. Engage short to earth switch on amp rear door

e. Remove the center of three (3) rear doors.

f. Utilize shorting stick to ground isolated supplies, AM assembly, and thyratron deck assembly.

g. Hang ground stick from thyratron deck assembly

h. Remove the (4) 7/16" nuts and cover of AM assembly

i. Locate R1 and attach current source and external meter.

j. Replace rear door taking care not to disturb test set up.

k. Disengage short to earth switch and rotate cabinet isolator to on (1) position.

l. On the switch meter panel select body current

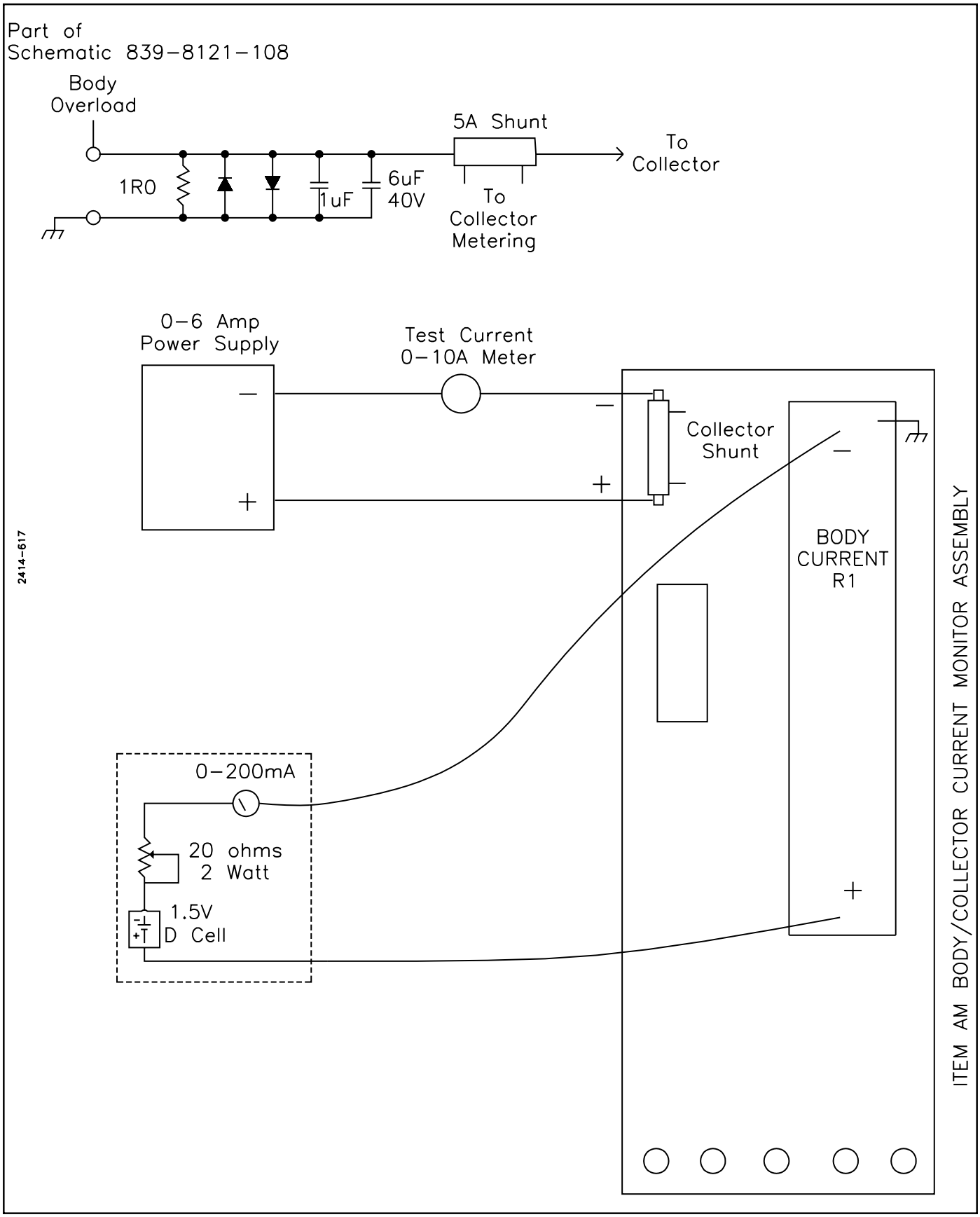


Figure 5-7. Equipment Connections for Body/Collector Current Meter Calibration

WARNING: Disconnect primary power prior to servicing.

m. Open the amp control panel and loosen the 2 captive thumb screws to obtain access to the digital/voltage PCB

n. Locate Pots R253 meter null, R243 body current calibrate, and R242 body current trip.

o. Adjust R253 to zero body current meter

p. Slowly increase current source to 100 mA as indicated on external meter ensuring meter is not pegging negative. If this occurs reverse polarity of current source

q. Adjust R243 to a calibrate body current meter for 100 mA

r. Adjust the current supplied and R242 Trip for a body current trip at 100 mA. This may need to be repeated several times to ensure accuracy.

s. Rotate cabinet isolator to OFF (0) position. Remove test equipment and return transmitter to normal condition.

5.14.9.1 Bias current overload

a. On the amplifier cabinet rotate the cabinet isolation switch to off. Engage the short to earth switch, and remove the center and left hand cabinet doors, utilizing the ground stick ground on all HV components. i.e.: Thyratron floating deck, Isolated supplies, etc.

b. Locate the grid current meter on the meter assembly. Just to the right of the meter is a Terminal Board with VI Transorb attached. Attach a 1 k ohms for 80 mA or 400 ohms for 150 mA (This may be increased due to EEV specs) in parallel with VI.

c. Reinstall the rear covers. Rotate the short to earth switch to operate position. Rotate the cabinet isolator switch to the on (1) position.

d. Depress the BK heat command and slowly increase bias voltage adjust potentiometer located just below the metering window until bias current reads 80 mA or 150 mA. At this point a grid bias n0rmal led will extinguish. If not de-energize amplifier cabinet repeat procedure to gain access to the isolated supplies.

e. Remove 7 screws securing shielding cover for the isolated supplies board. Locate and adjust R37 CW to increase trip point (refer to Table 5-4). Reassemble shielding, replace all covers, and then test trip point. This procedure may require several attempts to set the trip accurately.

f. Remove test resistor and return transmitter to operational condition.

5.14.9.2 ION Pump Current Overload

To test the logic remove fiber optic cable #H15 on the Digital to Analog Interface. This should illuminate the ion current fault indicator if beam voltage is present, and lockout the transmitter. The logic should allow reapplication of beam voltage to pump the tube down.

To test the sensor, it will be necessary to connect 620 M ohms resistance from the ION current meters to the isolated supplies chassis. This will induce 5 mA indicated ion current.

5.14.9.3 VSWR Overload

This procedure consists of using RF power from the IPA FWD PWR Directional Coupler UX3 connected to the Peak detector VSWR Input to drive the VSWR Metering and the overload circuit.

NOTE

The CD-1A exciter can also be used to drive the VSWR metering and overload circuit.

The VSWR peak detector cable is accessible from the Break away assembly.

a. Remove reflected power sample from the break away directional coupler WW1.

b. Reattach cable to IPA directional coupler UX4.

c. Reduce exciter/drive power to minimum by rotating R19 Auto O/P Power pot on the IOT R.F. Corrector CCW.

d. Disable the IPA/Drive Mute by grounding X28 PIN 9 on the IOT LOGIC Interface Board.

e. Slowly rotate Power Control pot on the IOT AGC and UHF Linearizer until the VSWR Meter indicates 1.4.

f. Adjust R47 VSWR TRIP on the digital and analog PC to illuminate VSWR Overload.

g. Check VSWR foldabck to activate at 1.35:1 VSWR.

h. Remove temporary cables/jumpers and reconnect VSWR sample cable to WW2 on RF break away.

i. Rotate R19 Auto O/P Power pot on the IOT RF Corrector to obtain 100% rated transmitter power.

5.14.9.4 ARC Overload

This procedure consists of temporarily substituting the Cavity ARC Sensors with a known fixed resistance. The overload sensitivity, however, is fixed and cannot be adjusted without altering the resistance values of the appropriate overload input circuit.

a. Disconnect the Cavity ARC Sensor from the cavity under test.

b. Temporarily connect a 1M ohm resistor between PINS A-F of connector X13 or X14. (X13 for primary output cavity; X14 for secondary cavity). The ARC OVLD LED should illuminate.

c. Remove the 1M ohm resistor and reconnect X13, X14 to appropriate cavities.

d. Depress output cavity Arc Test push button, the overload LED should illuminate.

e. Depress secondary cavity Arc Test push button, the overload should illuminate.

5.14.9.5 Cabinet Overtemp

The 2 temperature cabinet sensors are located on the bulkhead of the upper left side of the tube cabinet and upper right side of the IPA cabinet. Remove one of the two spade lugs from the temperature sensors. The cabinet temp OVLD LED should illuminate. Reset indicator and test the second sensor. (Note: It is normal for metering panel lamps to extinguish during this test, as the 24 VAC is utilized for this interlock.).

5.14.9.6 HV second step fail

On the IOT Logic & Control PCB locate Jumper X26 strap a-b and the HV 2nd step fail LED will illuminate. Return jumper X26 to b-c position for normal operation. Reset Faults.

5.14.9.7 Collector Over Temperature

Locate the Temp Sensor on the IOT collector cooling outlet. Remove one of the spade lug connections. The collector over temp OVLD LED should illuminate. Reset Faults.

5.14.9.8 Crowbar Fired

On the Digital & Analogue PCB locate the crowbar test fire switch S-1 and depress. The crowbar will fire, LCC CB1 will trip and recycle and the Crowbar Fired OVLD LED will illuminate. Reset Overload.

5.14.9.9 Motor O/L

The motor overload protection for the cavity fan consists of an overload sensor attached to contactor K1 in the Contactor and Circuit Breaker Drawer assy.

a. Cavity blower trip - 2.5 Amps
b. The transmitter should be switched off and isolated.
c. With an ohmmeter check that by depressing the test button on the motor overload breaker the logic output contacts from the breaker go from short circuit to open circuit.
d. Set cavity blower overload relay K1 to 2.5 Amps.
e. Set the motor overload breaker to auto and remove the logic output wire from the breaker trip connection.
f. Replace the safety cover and after reapplying power to the transmitter select standby.
g. The transmitter should not run up, but indicate motor overload on the amplifier control panel.
h. Switch the amplifier to off again and isolate.
i. Access the circuit breaker assy and replace wire removed in step e , replace the safety cover and after reapplying power to the transmitter select standby.
j. The transmitter should now run up without indicating motor overload on the amplifier control panel.
k. Reset Lock out and Overload faults.

5.14.10 Conditioning Procedure for a new IOT or spare IOT in or coming out of extended storage

a. Pretune the cavities or reinstall cavities after replacement of tube.
b. Assure the IOT is terminated in 50 Ohms.
c. Set Line Control Cabinet (LCC) Breakers to on (1) position.
d. Depress Standby command. Set heater, voltage, and magnet current to the values specified on the tube test data sheet. Increase bias voltage to 120 V to put the tube into cutoff.
e. Observe the ION pump current when heaters are energized. A new tube or a tube that has been in storage may draw ion current when heaters are energized. This should clear in a few minutes and should became shorter in duration each time the heaters are energized as the vacuum improves.
f. Tap beam supply for lowest voltage.
g. After 10 minutes of heater operation, depress beam on command. Collector current should be 0 Amps. After 30 minutes, adjust bias voltage for 0.2 Amps collector current.
h. In several steps gradually increase beam voltage until it equals the value given in the IOT test data sheet. Ensure that the collector current is 0.2 to 0.4 Amps quiescent at each beam tap. Readjust bias voltage as necessary.
i. Refer to tuning procedures and gradually bring up RF drive, tune the IOT and operate at full beam current for two hours.

5.14.11 IOT Beam Current Adj

The beam current in each IOT is determined by the bias voltage applied to the grid.

Increasing bias voltage (more negative) will decrease collector current while decreasing bias voltage (Less negative) will increase collector current.

5.15 Heat Exchanger Adjustments

a. Thermostat adjustments

   Disconnect primary power to the heat exchanger. Loosen the three 7/16 inch bolts on the electrical panel access cover. The thermostats are located behind the panel on the bottom left side of the electrical panel. Set the thermostats to energize in ten degree increments starting at 90 degrees.

b. Circuit setters (If utilized)

   Using a Bell & Gossett Differential Pressure Meter measure across the circuit setter valve located near the pump modules. Convert the pressure difference using the circuit setter balance valve calculator to GPM and set recommended flow rate for the installed system. The specific system requirements are listed in the overall transmitter flow diagram.

c. Strainer removal and cleaning

   Isolate the strainer using the supply and return pump isolation gate valves. Remove the strainer inspection cap. This will allow access to the strainer screen. Thoroughly clean the screen and reassemble the strainer assembly. Return isolation valves to open position.

WARNING: Disconnect primary power prior to servicing.

Table 5-3. Digital & Analog Interface

X12
a-b spare inputs latching enable
b-c spare inputs latching disable
X13
a-b spare inputs latching enable
b-c spare inputs latching disable
X24
Link X24 when input cooling 2 not used
X25
Link X25 when input cooling 3 not used
X27
Tube over temp
X28
a-b latching disabled
b-c latching enabled
X30 IPA Metering Port
a-b for normal
b-c for data stream

Table 5-4. Isolated Supplies P.C.B.

R-120	Heater Volts Meter Cal
R- 38	Grid Current Overload Set Point

Table 5-5. Digital & Analogue Interface

P.C.B.	Potentiometer Functions
R-51	Forward Power Meter Calibrate
R-50	Forward Power Status Trip Point
R-48	IPA Power Meter Calibrate
R-49	IPA Power Status Trip Point
R-46	VSWR Meter Calibration
R-47	VSWR Trip Point
R-238	Tube Overtemp Trip
R-239	High Voltage Meter Calibrate
R-240	Beam Current Meter Calibrate
R-255	Beam Current Meter Zero Set
R-241	Beam Current Overload Trip Point
R-243	Body Current Meter Calibrate
R-253	Body Current Meter Zero Set
R-242	Body Current Overload Trip Point

WARNING: Disconnect primary power prior to servicing.

Table 5-6

"N" = Amplifier Cabinet Logic Board Jumpers and DIP Switch Settings
NX1 a-b for background heat b-c for black heat
NX2 a-b to disable latching b-c to enable latching
NX3 a-b for normal b-c for ready
NX4 a-b for normal b-c for ready
NX8 a-b spare inputs latching enable b-c spare inputs latching disable
NX9 a-b spare inputs latching enable b-c spare inputs latching disable
Placement of the link in X10, X11 and X12 a- determines the lockout status of the transmitter.
NX10 a — b OFF
NX11 a — b BK/HEAT
NX12 a — b STANDBY
NX13 a-b for all controls b-c for separate local
NX14 Remote Controls a-b Link high for O/C b-c Link low for TTL
NX15 Remote Controls Link for 5V to 12V operation

open for 24V operation
NX16 Remote Controls Link for 5V to 12V operation open for 24V operation
NX17 Remote Controls Link for 5V to 12V operation open for 24V operation
NX18 Remote Controls Link for 5V to 12V operation open for 24v operation
NX19 Remote Controls Link for 5V to 12V operation open for 24V operation
NX20 Selects 3 or 4 shot operation of all a-b 3 shot overloads linked for multiple b-c 4 shot Reset before lockout
NX21 Secondary cavity arc a-b 3 shot b-c single shot
NX22 VSWR trip a-b 3 shot b-c single shot
NX23 Spare overload input a-b 3 shot b-c single shot
NX24 Spare overload input a-b 3 shot b-c single shot
NX25 Primary cavity arc a-b 3 shot b-c single shot
NX26 a-b to test b-c normal operation

NX27 crowbar fired a-b 3 shot b-c singles shot
For 120 Seconds SW1 - on/low SW2 - on/low SW3 - on/low SW4 - off/high SW5 - off/high SW6 - off/high SW7 - off/high SW8 - on/low
For 300 Seconds SW1 - on/low SW2 - on/low SW3 - off/high SW4 - on/low SW5 - off/high SW6 - on/low SW7 - off/high SW8 - on/low
For 600 Seconds SW1 - on/low SW2 - off/high SW3 - off/high SW4 - on/low SW5 - off/high SW6 - on/low SW7 - on/low SW8 - off/high
S5 & S6 SW1 - on/low SW2 - off/high SW3 - off/high SW4 - on/low SW5 - off/high SW6 - on/low SW7 - on/low SW8 - off/high
300 / 600 S7 & S8 SW1 - on/low SW2 - off/high SW3 - off/high

SW4 - on/low SW5 - off/high SW6 - on/low SW7 - on/low SW8 - off/high
SEC STAND BY TIMER BKHEAT 300/600 B-HEAT S3 & S4 SW1 - on/low SW2 - off/high SW3 - off/high SW4 - on/low SW5 - off/high SW6 - on/low SW7 - on/low SW8 - off/high

WARNING: Disconnect primary power prior to servicing.

WARNING: Disconnect primary power prior to servicing.

6.1 Introduction

In the event of a problem, the trouble area must first be isolated to a particular area such as an Exciter, IPA input, IPA Power Supply, or a module of the RF component. Most troubleshooting consists of visual checks. The meters and indicator lamps will give immediate indication of many of the failures that will occur.

Once the trouble is isolated to a specific area, refer to the theory section of the appropriate technical manual for circuit discussion to aid in problem resolution. If parts are required, refer to Parts List in appropriate technical manual.

6.2 Technical Assistance

See Technical Assistance clause on back of manual title page.

6.3 Safety Precautions to Observe While Troubleshooting

Read safety warning and first aid information before proceeding.

WARNING

USE BREAKERS OR DISCONNECT SWITCHES TO REMOVE ALL PRIMARY POWER TO THE TRANSMITTER AND PERIPHERAL EQUIPMENT BEFORE OPENING ENCLOSURES, OR REMOVING ANY PANEL OR SHIELD.

Do not rely on internal contactors, relays, interlocks, or switching devices to remove all dangerous voltages.

Use grounding stick to discharge high voltage points before touching any points within the enclosure.

If a voltage reading or waveform analysis is required, route test leads through an opening in the cabinet to the desired measurement point. Secure leads away from any circuit with voltages beyond the break down point of their insulation or the isolation rating of the measuring device. Do not hold any measuring device in your hand while the equipment is energized. Securely ground the chassis of any oscilloscope, analyser, or other test equipment.

Close cabinet doors and replace all panels before applying power and taking readings.

Do not attempt measurement of any circuits of transmitters sub-assembly with chassis floating at high voltage (i.e. DC filament assembly, rectifiers, Ion-Pump power supply, or Crowbar) while the Beam Supply is energized.

After taking a reading, use breakers or disconnect switches to again remove all primary power to the Transmitter and peripheral equipment before opening enclosure where test leads were routed or connected. Use grounding stick to discharge all high voltage points and points where test leads are attached before touching any points or removing test leads.

Do not work alone or when tired or otherwise incapacitated.

6.4 Cabinet Views

Figures 6-1 thru 6-4 show cabinet views of the IOT Transmitter.

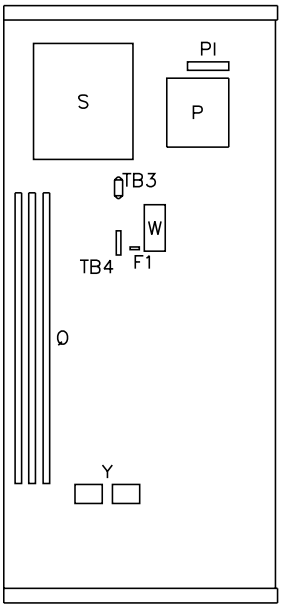
Each subassembly is shown with a letter designation. The corresponding letter designations are used in the Cabinet Wiring Diagrams.

6.5 Component Designators

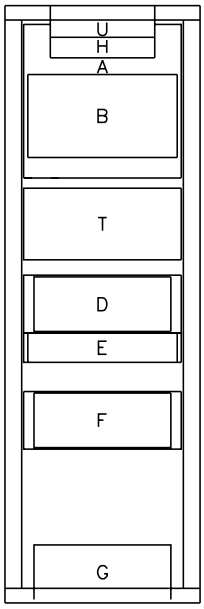
See Table 6-1 for a listing of component designators as used in this manual.

WARNING: Disconnect primary power prior to servicing.

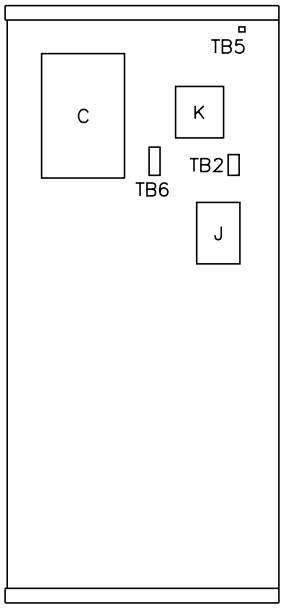
CONTROL CABINET



SIDE ON LEFT



VIEW FROM
REAR OF CABINET
(REAR DOOR OPEN)



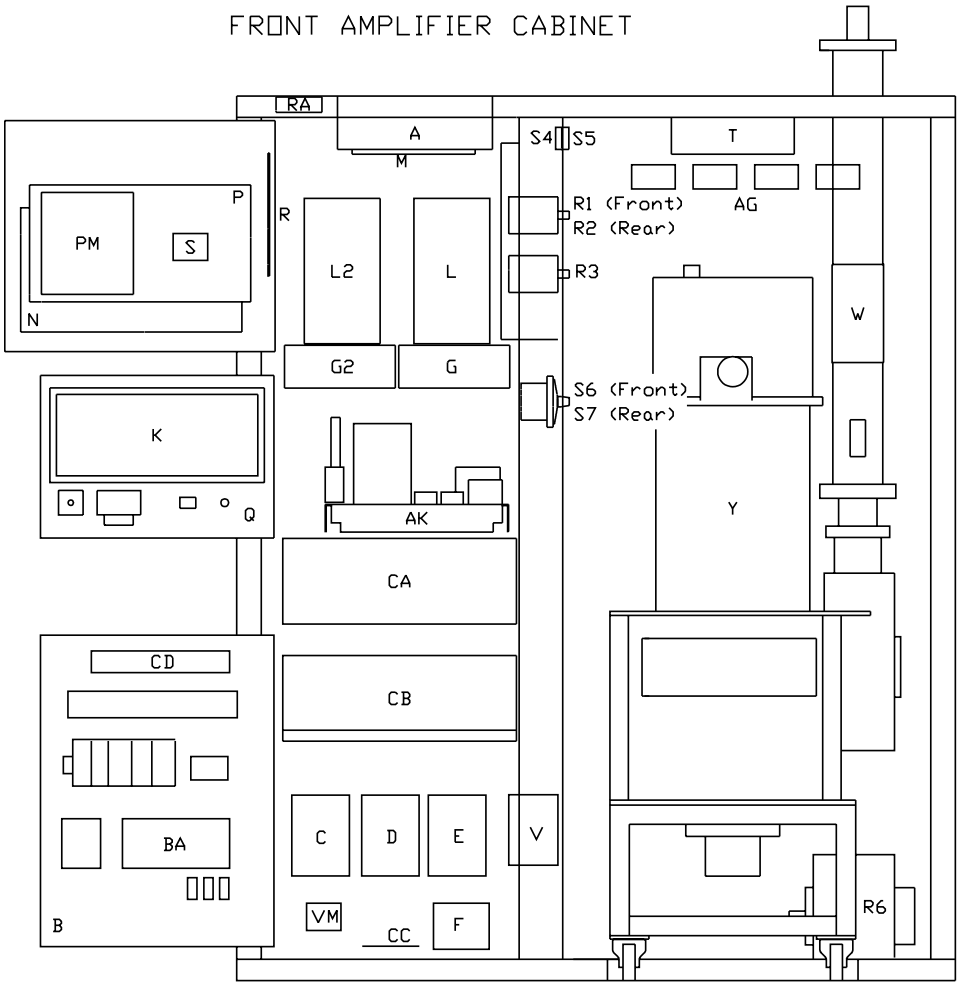
SIDE ON RIGHT

A	SYSTEM CONTROL PANEL
B	SYSTEM CONTROL PCB
C	SYSTEM INTERFACE PCB
D	EXCITER A (OPTIONAL)
E	CHANGEOVER UNIT (OPTIONAL)
F	EXCITER B (OPTIONAL)
G	POWER SUPPLY DECK
H	CUSTOMER INTERFACE
J	PSU DISTRIBUTION PCB
K	LO DA
P	POWER METER PCB
PI	POWER METER SUB PCB
Q	PHASE LINE STRETCHERS (OPTIONAL)
S	MODE CONTROLLER PCB
T	MODE CONTROLLER CONTROL PANEL
U	INTERLOCK MARSHALLING PCB
W	RF SYSTEM 12 VOLT PSU
Y	PHASE CHANGE RELAYS (OPTIONAL)
F1	FUSE – RF SYSTEM DC OUTPUT
TB1	POWER SUPPLY DISTRIBUTION
TB2	MAINS TERMINAL BLOCK
TB3	RF SYSTEM PSU MAINS
TB4	RF SYSTEM PSU DC OUT
TB5	PHASE ADJUST
TB6	DC DISTRIBUTION

2414f603 from
COMPONENET DESIGNATOR 839–8205–069 REV A.

Figure 6-1

WARNING: Disconnect primary power prior to servicing.



A INTERFACE PANEL
B CONTACTOR/CIRCUIT BREAKER DOOR
C IPA PSU 1
D IPA PSU 2
E IPA PSU 3
F IPA PSU PARALLELING ASSEMBLY
G IPA BLOWER
G2 IPA BLOWER 2
K AGC/UHF LINEARIZER
L IPA AMPLIFIER 1
L2 IPA AMPLIFIER 2
M CABINET FAN (IPA ENCLOSURE)
N LOGIC PCB
P A/D INTERFACE PCB
Q SWITCHED METER PANEL ASSEMBLY
R LOGIC INTERFACE PCB
S CONTROL PSU DISTRIBUTION PCB
S4 THERMOSTATS (IPA ENCLOSURE)
S5 THERMOSTATS (IOT ENCLOSURE)
S6 IPA AIR SWITCH
S7 IOT AIR SWITCH
T CABINET FAN (IOT ENCLOSURE)
V CONTROL PSU
W IOT OUTPUT FEEDER PROBE ASSEMBLY
Y IOT TROLLEY ASSEMBLY
AG ISOLATED METERS ASSEMBLY
AK FEEDFORWARD ASSEMBLY
BA CONTACTOR DRIVER PCB
CA EXCITER A (OPTIONAL)
CB FOCUS SUPPLY
CC FUSE FAILURE DRIVER PCB
CD FUSE FAILURE INDICATOR PCB
PM POWER METER PCB
RA EMI FILTER ASSEMBLY
R1 BLACK HEAT FILAMENT VOLTS ADJUST
R2 FULL HEAT FILAMENT VOLTS ADJUST
R3 FOCUS ADJUST
R6 (RF Load) IOT CIRCULATOR LOAD
VM MOV

2414f602 from
COMPONENET DESIGNATOR 839-8205-068 REV B.

Figure 6-2

WARNING: Disconnect primary power prior to servicing.

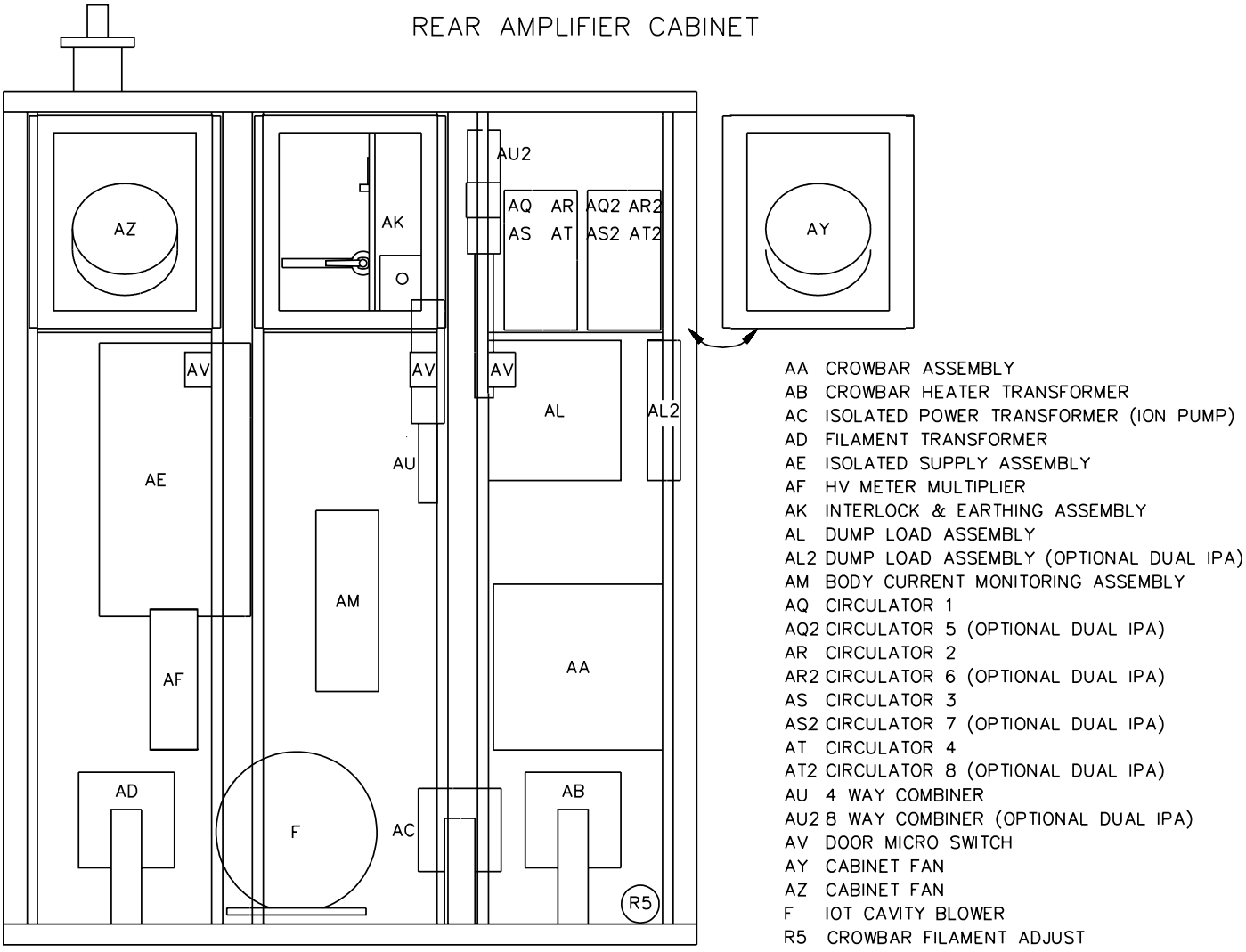


Figure 6-3

WARNING: Disconnect primary power prior to servicing.

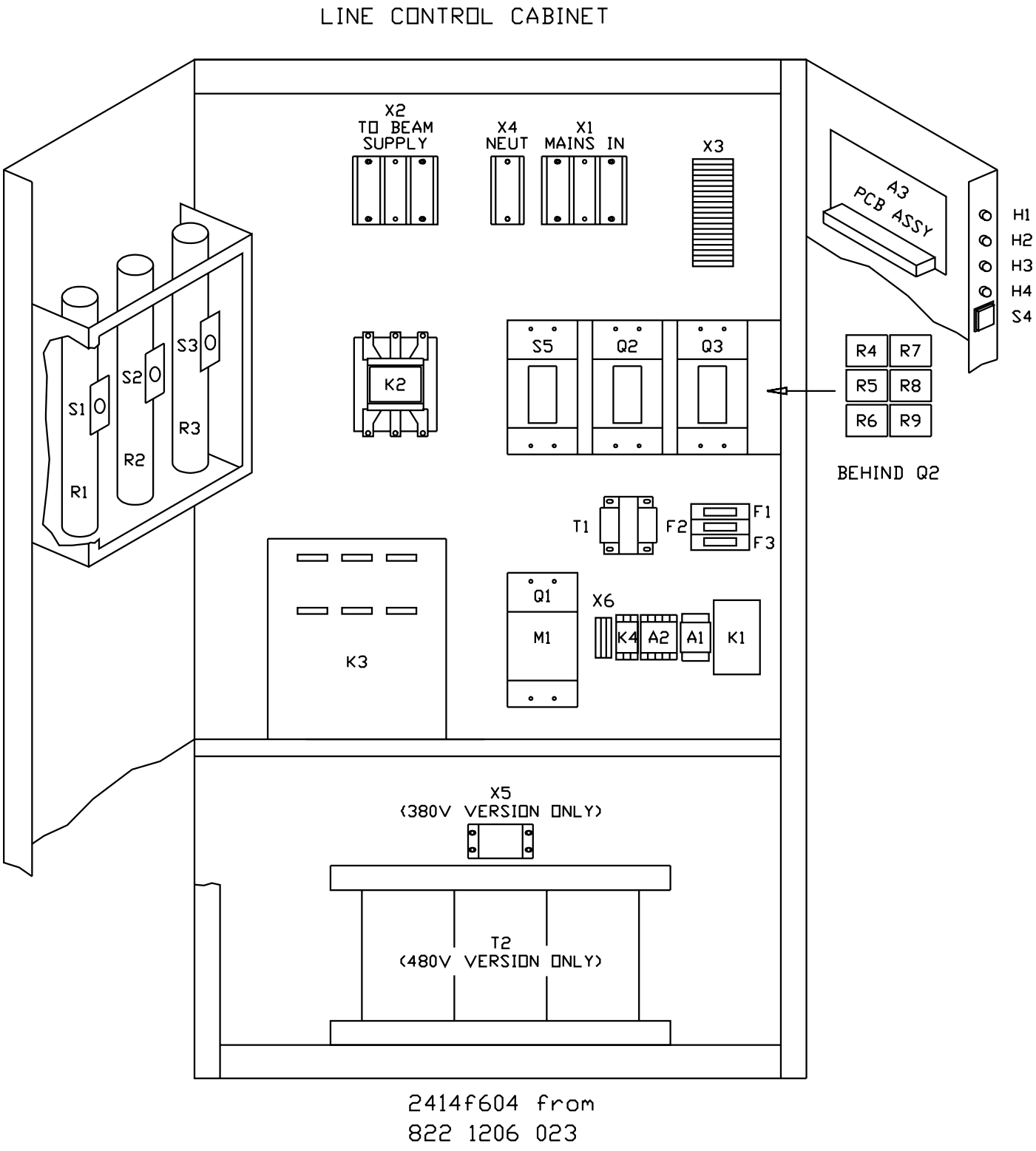


Figure 6-4

WARNING: Disconnect primary power prior to servicing.

Table 6-1. Component Designators

Letter codes for the designation of kind of item:		
Letter code	Kind of item	Examples
A	Assemblies, subassemblies	Amplifier with tubes or transistors, magnetic amplifier, laser, master.
B	Transducers, from non-electrical quantity to electrical quantity or vice-versa	Thermo-electric sensor, thermo cell, photo-electric cell, dynamometer, crystal transducer, microphone, pick-up, loudspeaker, synchros, resolvers.
C	Capacitors	
D	Binary elements, delay devices, storage devices	Combinative elements, delay lines, bistable elements, monostable elements, core storage, register, magnetic tape recorder, disk recorder.
E	Miscellaneous	Lighting devices, heating devices, devices not specified elsewhere in this Table.
F	Protective devices	Fuse, over-voltage discharge device, arrester.
G	Generators, supplies	Rotating generator, rotating frequency converter, battery, supply device, oscillator, quartz-oscillator.
H	Signalling devices	Optical and acoustical indicators.
K	Relays, contactors	
L	Inductors	Induction coil, line trap.
M	Motors	
P	Measuring equipment, testing equipment	Indicating, recording and integrating measuring devices, signal generator, clocks.
Q	Mechanical switching devices for power circuits	Circuit-breaker, isolator.
R	Resistors	Adjustable resistor, potentiometer, rheostat, shunt, thermistor.
S	Switches, selectors	Control switch, push-buttons, limit switch, selector switch, selector, dial contact, connecting stage.
T	Transformers	Voltage transformer, current transformer.
U	Modulators, changers	Discriminator, demodulator, frequency changer, coder, inverter, converter, telegraph translator.
V	Tubes, semiconductors	Electronic tube, gas-discharge tube, diode, transistor, thyristor.
W	Transmission paths, waveguides, aerials	Jumper wire, cable, busbar, waveguide, waveguide directional coupler, dipole, parabolic aerial.
X	Terminals, plugs, sockets	Disconnecting plug and socket, test jack, terminal board, soldering terminal strip.
Y	Electrical operated mechanical devices	Brake, clutch, pneumatic valve.
Z	Terminations, hybrid transformers, filters, equalizers, limiters	Cable balancing network, compandor, crystal filter.

WARNING: Disconnect primary power prior to servicing.

Section VII
Parts List

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Table 7-1. SYSTEM, CD70P1/CD100P1 - 994 9648 005

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (m)*
051 1010 021	UCARTHERM COOLING FLUID	0.0 EA	QTY AS ORDERED BY CUSTOMER.
378 0170 000	THYRATRON, CERAMIC	0.0 EA	LINE ITEM SPARE
378 0195 000	TUBE, IOT 70KW, WATER COOLED	0.0 EA	LINE ITEM SPARE 70KW TUBE
378 0197 000	TUBE, IOT 110KW, WATER COOLED	0.0 EA	LINE ITEM SPARE 100KW TUBE
378 0218 000	KLYSTRODE, K2D75W	0.0 EA	LINE ITEM SPARE 75KW TUBE
378 0219 000	KLYSTRODE, K2D110W	0.0 EA	LINE ITEM SPARE 110KW TUBE
432 0409 000	FLUID COOLER 2 FAN	1.0 EA	
620 2950 000	ADAPTER, DIELECTRIC TO MYAT	0.0 EA	ORDER QTY 1 FOR DIELECTRIC RF SYSTEM
620 3045 000	RF SYSTEM DTV 1-TUBE PASSIVE	0.0 EA	PASSIVE POWER PROD, QTY 1 FOR CH 14-40
620 3046 000	RF SYSTEM DTV 1-TUBE PASSIVE	0.0 EA	PASSIVE POWER PROD, QTY 1 FOR CH 41-69
620 3053 000	RF SYS DTV 1-TUBE DIELECTRIC	0.0 EA	DIELECTRIC, ORDER QTY 1 FOR CH 14-17
620 3054 000	RF SYS DTV 1-TUBE DIELECTRIC	0.0 EA	DIELECTRIC, ORDER QTY 1 FOR CH 18-43
620 3055 000	RF SYS DTV 1-TUBE DIELECTRIC	0.0 EA	DIELECTRIC, ORDER QTY 1 FOR CH 44-69
736 0322 000	POWER SUPPLY BEAM 480VAC 96KVA	1.0 EA	
952 9211 100	KIT, WATER PLUMBING 1 TUBE	1.0 EA	
988 2414 100	DP, 1-TUBE, CD70P1/CD100P1	2.0 EA	
988 8641 001	*DP, SIGMA+ IPA W/FEED FORWARD	2.0 EA	
992 6742 005	GLYCOL PUMP MODULE, IOT	1.0 EA	
992 8723 001	INSTALL MATL, 1-TUBE IOT	1.0 EA	
992 8724 001	LINE CNTL CAB, 480V 60HZ	1.0 EA	
992 8734 001	*MODULE, 1KW S.S. AMPLIFIER	0.0 EA	LINE ITEM SPARE
992 8812 001	CALORIMETRY ASSEMBLY	0.0 EA	OPTION QRDER QTY 1
992 9139 012	KIT, INSTALLATION, 4" LINE	0.0 EA	
992 9508 001	ASSY, AUTO-CHANGEOVER CTLR	0.0 EA	ORDER QTY 1 FOR AUTO PUMP CHANGE-OVER
992 9511 066	INTERCONNECT CABLES, 1-TUBE CD	1.0 EA	
994 9648 001	*XMTR, 1-TUBE, SIGMA	0.0 EA	
994 9648 004	XMTR-Q, CD70P1/CD100P1	0.0 EA	ORDER 1 FOR QUINCY BUILT, QUINCY WILL FORMAT TO CHANNEL
994 9797 001	*KIT, SPARES, PC BOARD,	0.0 EA	
994 9797 003	*KIT, SPARE, PARTS	0.0 EA	
994 9797 004	*KIT, SPARES, SEMICOND & FUSE	0.0 EA	
994 9797 007	*KIT, SPARES, PC BOARD	0.0 EA	
994 9797 009	*KIT, SPARES, PC BOARD	0.0 EA	
994 9797 012	KIT, SPARES,AMP CAB COMPONENTS	0.0 EA	
994 9797 013	KIT, SPARES, LINE CONTROL CAB	0.0 EA	
994 9797 015	*KIT, SPARES, 97KVA BEAM POWER	0.0 EA	
994 9797 016	KIT, SPARES,FLUID COOLER SIGMA	0.0 EA	
994 9797 017	KIT, SPARES, PUMP MODULE	0.0 EA	
HEW8482H	HEWLETT PACKARD SENSOR PROBE	0.0 EA	OPTION ORDER QTY 1.
HEWEPM-441A	POWER METER, RF	0.0 EA	OPTION ORDER QTY 1.

Table 7-2. KIT, WATER PLUMBING 1 TUBE - 952 9211 100

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (n)*
003 8020 040	CU, TBG 1.0 NOM DIA	0.0 FT	60 REQ'D
003 8020 050	CU, TBG 1.5 NOM DIA	0.0 FT	80 REQ'D
003 8020 060	CU, TBG 2.0 NOM DIA	0.0 FT	20 REQ'D
086 0004 038	SOLDER, SILVER SIZE 0.062	0.0 LB	1 REQ'D

WARNING: Disconnect primary power prior to servicing.

086 0004 040	* STAY CLEAN FLUX	0.0 EA	1 REQ'D
086 0004 047	SOLDER, SILVER SIZE .125"	0.0 LB	1 REQ'D
299 0018 000	THREAD-TAPE, TEFLON	0.0 RL	1 REQ'D
358 1722 000	CLAMP, ADJ, SIZE 20	0.0 EA	8 REQ'D
358 3038 000	HOSE BARB 1" H X 1" MPT	0.0 EA	4 REQ'D
358 3348 000	HOSE CAP, 3/4 HOSE THD.	0.0 EA	5 REQ'D
359 0085 000	PLUG, PIPE BRASS	0.0 EA	1 REQ'D
359 0192 000	ELBOW, 90 DEG 1" CXC	0.0 EA	12 REQ'D
359 0193 000	TEE 1 IN	0.0 EA	2 REQ'D
359 0197 000	ADAPTER FEMALE FITTING	0.0 EA	4 REQ'D, #HOSE BARB
359 0199 000	UNION, 1" CXC	0.0 EA	2 REQ'D, #AMPLIFIER CABINETS
359 0200 000	ELBOW, 90 DEG STREET	0.0 EA	(OPTIONAL)
359 0225 000	ADAPTER 1" C X 1" M	0.0 EA	3 REQ'D, #DIELECTRIC LOAD
359 0228 000	ELBOW 45 DEG, 1" CXC	0.0 EA	4 REQ'D
359 0230 000	TEE 1.5"C X 1.5"C X 1.0"C	0.0 EA	2 REQ'D
359 0246 000	ELBOW, 90 DEG 1-1/2 CXC	0.0 EA	15 REQ'D
359 0250 000	ADAPTER, FEMALE	0.0 EA	4 REQ'D, #HOSE BARBS
359 0251 000	VALVE, GATE 1"CXC BRONZE	0.0 EA	2 REQ'D, #TOP OF AMPLIFIER CABINET.
359 0252 000	VALVE, GATE 1-1/2 CXC	0.0 EA	1 REQ'D
359 0260 000	ELBOW 45 DEG 2 IN	0.0 EA	2 REQ'D
359 0272 000	ELBOW, 90 DEG 2" CXC	0.0 EA	5 REQ'D
359 0302 000	ELBOW 90 DEG STREET	0.0 EA	2 REQ'D
359 0321 000	PLUG PIPE 1/8 NPT	0.0 EA	2 REQ'D, (#CALORIMETRIC TEST LOAD)
359 0324 000	VALVE GLOBE 1" CXC BRONZE	0.0 EA	2 REQ'D, TEST LOAD
359 0355 000	ADAPTOR 3/4 - 1/2	0.0 EA	5 REQ'D
359 0403 000	COUPLING 1" CXC	0.0 EA	4 REQ'D
359 0418 000	ELBOW 90 DEG STREET	0.0 EA	(OPTIONAL)
359 0435 000	UNION C X M 1-1/2 IN	0.0 EA	2 REQ'D, #USED WITH BALANCE SETTER
359 0454 000	COUPLING 1-1/2 X 1	0.0 EA	2 REQ'D
359 0476 000	ADAPTER 2" CXM	0.0 EA	1 REQ'D
359 0477 000	UNION, 2" CXC	0.0 EA	3 REQ'D
359 0479 000	VALVE, GATE 2" CXC	0.0 EA	2 REQ'D
359 0480 000	UNION 2 IN C X 2FPT	0.0 EA	2 REQ'D
359 0514 000	ADAPTER 2 IN	0.0 EA	1 REQ'D
359 0539 000	COUPLING 2 X 1-1/2	0.0 EA	1 REQ'D
359 0594 000	UNION, 3/4 CXM CAST	0.0 EA	2 REQ'D
359 0767 000	TEE 1-1/2 X 1-1/2 X 3/4	0.0 EA	3 REQ'D
359 0829 000	UNION 1" CXM	0.0 EA	4 REQ'D
359 0868 000	REDUCER FTG 2-1/2"X1-1/2"	0.0 EA	1 REQ'D
359 0883 000	ADPTR, FTG 1" FTG X 1/2"F	0.0 EA	1 REQ'D
359 0891 000	TEE, 1 X 1/8 X 1	0.0 EA	2 REQ'D, (#CALORIMETRIC TEST LOAD)
359 0955 000	VALVE, BALANCE/SETTER	0.0 EA	1 REQ'D
359 0984 000	REGULATOR, PRESS REDUCING	0.0 EA	1 REQ'D
359 0997 000	BOILER DRAIN, 1/2"	0.0 EA	5 REQ'D
359 1042 000	TEE 2"X2"X3/4" COPPER	0.0 EA	2 REQ'D
359 1075 000	ADAPTER FTG X M 1 X 3/4	0.0 EA	2 REQ'D, #PASSIVE POWER LOAD
359 1079 000	TEE 1X1X 3/4 CXCXC	0.0 EA	1 REQ'D
359 1083 000	NIPPLE, 2" NPT X 6"L	0.0 EA	1 REQ'D
359 1236 000	ELBOW, 2" STREET45	0.0 EA	1 REQ'D
424 0469 000	HOSE SIL RUB 1" X 12' LG	1.0 EA	
432 0409 000	FLUID COOLER 2 FAN	0.0 EA	
442 0108 000	THERMOSTAT 185 DEG F N.C.	1.0 EA	
629 0059 000	FLOW MTR, 15GPM, 1" FNPT	1.0 EA	
646 1488 000	LABEL, CAUTION	1.0 EA	
852 9211 100	LAYOUT, WATER PLUMBING	0.0 EA	

WARNING: Disconnect primary power prior to servicing.

917 2336 066	ADAPTER THERMOSTAT	1.0 EA	
917 2336 112	LABEL INSTRUCTIONS,	1.0 EA	
952 9211 103	KIT, SUB ASSY PLUMBING, 1 TUBE	1.0 EA	
992 6742 005	GLYCOL PUMP MODULE, IOT	0.0 EA	SEE NEXT LEVEL B/M

Table 7-3. GLYCOL PUMP MODULE, IOT - 992 6742 005

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (ag)*
003 8020 113	TUBING POLYPROPYLENE	7.0 FT	
026 6010 001	NYLON, PROFILE .500 WIDE	0.750 FT	
041 1310 025	RUB SILICONE SPONGE	0.1140 RL	
041 1310 030	GASKET, RUBBER	10.670 FT	#BETWEEN FRONT PANELS
055 0120 230	CONDUIT 3/4 IN.	6.670 FT	
055 0120 232	CONN, STRAIGHT 3/4	2.0 EA	
055 0120 319	CONN 90 DEG INSULATED 3/4	2.0 EA	
063 1030 021	* PIPE SEALANT “PST”	0.0 EA	#USE AS REQ
335 0106 000	WASHER PLAIN .187 ID	4.0 EA	K007
354 0197 000	CONNECTOR SET SCREW TYPE	12.0 EA	#PUMPS
357 0038 000	BUSHING TEFLON	2.0 EA	#U001
358 1316 000	CLAMP, ADJ, SIZE 24	2.0 EA	#PIPE MTG ANGLES
358 1761 000	CLAMP ADJ.	2.0 EA	#PIPE MTG ANGLES
358 1823 000	CLAMP, ADJ, SIZE 48	2.0 EA	#PIPE MTG ANGLES
358 1974 000	SPEED NUT 10-32	44.0 EA	
358 2426 000	PLUG, WHITE 2" HOLE	4.0 EA	
358 2598 000	CABLE TIE MOUNT, 4-WAY	2.0 EA	
358 2635 000	CABLE TIE, PUSH MOUNT SNAP IN	23.0 EA	USED AS TIES FOR CABLE
358 3348 000	HOSE CAP, 3/4 HOSE THD.	2.0 EA	
358 3456 000	CARTRIDGE FILTER 10MICRON	2.0 EA	
358 3463 000	SEAL, TOGGLE SWITCH	1.0 EA	
358 3612 000	PLATE, BARRIER (282, 2-COND)	1.0 EA	#TB1
358 3637 000	PLATE, END STOP, DIN RAIL MTG	2.0 EA	#TB1
359 0495 000	SNUBBER, PRESSURE	1.0 EA	
359 1068 000	BULKHEAD FITTING 2"	2.0 EA	#TANK OUTLET INLET
359 1122 000	CONNECTOR, FEMALE	1.0 EA	#M001
359 1123 000	ELBOW MALE SWIVEL 90 DEG	1.0 EA	#M001
382 0296 000	IC, LM340K-12 ESD	1.0 EA	U001
384 0431 000	RECT. 1N4001 ESD	2.0 EA	CR002 CR003
384 0694 000	LED RED CART 12V	2.0 EA	DS005 DS006
384 0695 000	LED GREEN CART 12V ESD	4.0 EA	DS001 DS002 DS003 DS004
384 0702 000	RECT FW BRIDGE 600V 35A ESD	1.0 EA	CR001
384 0842 000	LED AMBER CART 12V	1.0 EA	DS007
398 0324 000	FUSE, 1.5A	1.0 EA	F001
398 0476 000	FUSE, 5A, 600V	3.0 EA	F002 F003 F004
402 0024 000	FUSE HOLDER	1.0 EA	XF001
402 0130 000	FUSE HOLDER, 3 POLE	1.0 EA	XF002 3 4
404 0578 000	SOCKET RELAY, 4PDT	2.0 EA	XK003 XK004
404 0661 000	SOCKET, TRANSISTOR TO-3	1.0 EA	XU001
404 0695 000	HEAT SINK FOR TO-3 CASE	1.0 EA	#U001
410 0391 000	INSULATOR TRANSISTOR T03	1.0 EA	#U001
424 0033 000	GROMMET 1-1/16 MTG D	3.0 EA	
424 0382 000	WASHER, RUBBER	1.0 EA	#LEVEL SW
432 0316 000	PUMP, WATER 60HZ 3 PH	2.0 EA	B001 B002
442 0041 000	THERMOMETER DIAL	1.0 EA	M002
448 0224 000	HANDLE ALUM	1.0 EA	
472 0622 000	XFMR CTL 115/230V 50/60HZ	1.0 EA	T002

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472 1047 000	XFMR, CTL, STEP DOWN, 1 PHASE	1.0 EA	T001
522 0531 000	CAP 1UF 50V 20%	1.0 EA	C003
524 0147 000	CAP 2600UF 50V	1.0 EA	C002
524 0150 000	CAP 6000 UF 50V	1.0 EA	C001
530 0088 000	BRACKET, CAP, 2" ID	1.0 EA	#C001
530 0094 000	BRACKET, CAP, 1.375"ID	1.0 EA	#C002
540 0287 000	* RES 13 OHM 1W 5%	1.0 EA	R002
540 0611 000	* RES 1K OHM 2W 5%	1.0 EA	R001
560 0035 000	MOV 4500A 35J 130 VAC	2.0 EA	RV001 RV002
570 0279 000	CNTOR 40A 600V 3P	2.0 EA	K001 K002
574 0156 000	RELAY 12VDC 4PDT	2.0 EA	K003 K004
582 0056 000	RELAY, OVERLOAD 3P 600V	2.0 EA	K005 K006
584 0273 000	HEATER B55	6.0 EA	HR001 HR002 HR003 HR004 HR005 HR006
604 1060 000	SWITCH, TGL DP ON OFF ON	1.0 EA	S001
604 1129 000	SWITCH, LIQUID LEVEL	1.0 EA	S002
604 1170 000	SWITCH, DISCONNECT 480V	2.0 EA	
614 0048 000	TERM BD 4 TERM	1.0 EA	TB003
614 0059 000	TERM BD 15 TERM	1.0 EA	TB002
614 0132 000	TERM STRIP 2 TERM	1.0 EA	TS001
614 0718 000	JUMPER MODEL 601-J/141J	2.0 EA	
614 0915 000	TERM BLK, 2C MODULAR 282	7.0 EA	#TB1
614 0920 000	JUMPER, 2-POLE ADJACENT 282	3.0 EA	#TB1
614 0921 010	MARKER STRIP, TERM BLK, 1-10	1.0 EA	#TB1
620 2726 000	GAUGE,PRESSURE 3.5IN DIAL	1.0 EA	
646 0665 000	INSPECTION LABEL	1.0 EA	
646 1483 000	HARRIS NAMEPLATE	1.0 EA	
740 1059 000	MON, PH 430-480V 3PH	1.0 EA	K007
817 2336 123	RUNNING SHT, PUMP MODULE	0.0 EA	
822 0218 001	STRAP, GND	1.0 EA	
822 0741 039	BRKT, U1 MTG	1.0 EA	#XU001
843 5396 221	WIRING DIAG, PUMP MODULE,	0.0 EA	
852 9190 609	OUTLINE DWG, IOT PUMP MOD	0.0 EA	
922 0965 152	FITTING, LEVEL SWITCH	2.0 EA	
922 0965 153	SHIELD, LEVEL SWITCH	1.0 EA	
922 1295 019	SHIELD, DEFLECTOR	1.0 EA	TB003
922 1297 054	RAIL, 4"	1.0 EA	TB1
943 4578 001	PUMP DISCHARGE ASSY	1.0 EA	
952 9190 600	CABINET ASSY	1.0 EA	
952 9190 607	VORTEX PLATE 2" OUTLET	1.0 EA	
952 9190 608	ENCLOSURE, TOP TANK	1.0 EA	
952 9190 610	TANK RETURN ASSY	1.0 EA	#TANK OUTLET
952 9190 611	PUMP INLET ASSY	1.0 EA	
952 9190 612	TANK, MODIFIED, 30 GAL	1.0 EA	
952 9190 618	ANGLE PIPE SUPPORT	5.0 EA	#PIPE SUPPORTS
952 9190 619	TOP ELECTRICAL PANEL	1.0 EA	
952 9190 620	PANEL, LOWER ELECTRICAL	1.0 EA	
952 9190 627	SIDE PANELS	2.0 EA	
952 9190 628	BLANK PANEL	1.0 EA	
952 9190 630	CABLE ASSY	1.0 EA	
994 9659 011	KIT, ADVANCED SPARES PUMP	0.0 EA	
999 2418 001	HARDWARE LIST, PUMP MODULE	1.0 EA	
999 2819 001	WIRE/TUBING LIST	1.0 EA	

Table 7-4. INSTALL MATL, 1-TUBE IOT - 992 8723 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (u)*
003 4010 050	CU, STRAP .020 X 4"	105.0 FT	
296 0350 000	TUBING, ZIPPER .625	100.0 FT	
302 0532 000	SCR, 1/2-13 X 1-1/4	8.0 EA	
308 0013 000	WASHER, FLAT 1/2	8.0 EA	
314 0015 000	WASHER, SPLIT-LOCK 1/2	8.0 EA	
354 0005 000	TERM LUG RED SPADE 6	50.0 EA	
354 0006 000	TERM LUG RED SPADE 8	50.0 EA	
354 0011 000	LUG BLUE RING .25	50.0 EA	
354 0015 000	LUG BLUE SPADE 6	50.0 EA	
354 0016 000	LUG BLUE SPADE 8	50.0 EA	
354 0017 000	LUG BLUE SPADE 10	50.0 EA	
354 0027 000	TERM LUG YEL SPADE 8	50.0 EA	
354 0245 000	TERM LUG YEL RING 10	50.0 EA	
354 0254 000	LUG .25 RING YEL	10.0 EA	
354 0325 000	LUG,.25 RING YEL 12-10AWG	10.0 EA	
354 0338 000	LUG 4 RING RED	50.0 EA	
354 0567 000	TERMINAL 3/8 RING	10.0 EA	
354 0700 000	LUG 3/8 RING FOR 18-14AWG	10.0 EA	
358 3192 000	EYEBOLT, 1/2-13 THDS.	4.0 EA	
464 0242 000	CHAIN HOIST 10 FT, 1 TON	1.0 EA	
464 0253 000	PLIERS, ZIPPER TUBING	1.0 EA	
614 0842 000	TERM BLOCK 4POS 380V 8A	4.0 EA	
614 0844 000	TERM BLOCK 10POS 380V 8A	6.0 EA	
690 0016 000	DUCT SEALANT, PUTTY	1.0 BX	
917 2336 023	CABINET CLAMP	3.0 EA	
917 2336 024	CABINET CLAMP	1.0 EA	
917 2501 103	INSTL, MTL, WIRE, USA 30/40KW	1.0 EA	
922 1311 003	CLAMP, CABINET INSTALLATION,	2.0 EA	# SIGMA CDII
992 3660 001	KIT, HARDWARE	1.0 EA	
992 9830 032	KIT, LINEARIZER INP ATTENUATOR	1.0 EA	
994 8442 001	KIT, PROBE (1.50); 6-1/8 LINE	1.0 EA	
994 8442 006	KIT, PROBE (1.25); 4-1/16 LINE	1.0 EA	

Table 7-5. KIT, LINEARIZER INP ATTENUATOR - 992 9830 032

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (a)*
556 0046 000	PAD, FXD 50 OHM 2DB	1.0 EA	
556 0047 000	PAD, FXD 50 OHM 3DB	1.0 EA	
556 0048 000	PAD, FXD 50 OHM 5DB	1.0 EA	
556 0049 000	PAD, FXD 50 OHM 6DB	1.0 EA	
556 0051 000	PAD, FXD 50 OHM 10DB	1.0 EA	

Table 7-6. TERM ASSY, X3, 480V 60HZ - 939 8205 045

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (a)*
358 3000 000	PLATE, END STOP, DIN RAIL MT	2.0 EA	
358 3611 000	PLATE, END COVER (280, 3-COND)	2.0 EA	
358 3612 000	PLATE, BARRIER (282, 2-COND)	2.0 EA	
614 0915 000	TERM BLK, 2C MODULAR 282	7.0 EA	X3-012 X3-013 X3-014 X3-015A X3-016 X3-017 X3-015B
614 0916 000	TERM BLK, 2C MODULAR 280	3.0 EA	X3-011A X3-011B X3-011C
614 0917 000	TERM BLK, 3C MODULAR 280	13.0 EA	

WARNING: Disconnect primary power prior to servicing.

			X3-001 X3-002 X3-003 X3-004 X3-005 X3-006 X3-007 X3-008 X3-009 X3-010A X3-019 X3-020
614 0919 000	JUMPER, 2-POLE ADJACENT 280	1.0 EA	#X-010
614 0920 000	JUMPER, 2-POLE ADJACENT 282	1.0 EA	#X-015
614 0921 010	MARKER STRIP, TERM BLK, 1-10	0.20 EA	
614 0921 020	MARKER STRIP, TERM BLK, 11-20	0.30 EA	
614 0923 000	TERM BLK, 2C MODULAR 282	2.0 EA	X3-018A X3-018B
839 8205 045	ASSY INSTR, X3, 480V 60HZ	0.0 EA	
922 1297 050	RAIL, DIN MOUNTING	1.0 EA	

Table 7-7. BASIC LINE CONTROL CAB - 992 8724 003

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (w)*
358 2598 000	CABLE TIE MOUNT, 4-WAY	20.0 EA	
358 3611 000	PLATE, END COVER (280, 3-COND)	1.0 EA	#X006
358 3637 000	PLATE, END STOP, DIN RAIL MTG	4.0 EA	#X006 #A001
384 0859 000	LED RED CART 24V ESD	1.0 EA	H004
384 0860 000	LED GREEN CART 24V ESD	3.0 EA	H001 H002 H003
398 0368 000	FUSE, CART 2A 600V	3.0 EA	F001 F002 F003
402 0130 000	FUSE HOLDER, 3 POLE	1.0 EA	XF
404 0848 000	RELAY SOCKET MODULE	1.0 EA	XA001
404 0863 000	SOCKET, RELAY 11 PIN	1.0 EA	#K004
424 0011 000	GROMMET 1-1/4 MTG DI	1.0 EA	
442 0123 000	THERMOSTAT 155 DEG F N.C.	3.0 EA	S001 S002 S003
448 0983 000	*LOCK SPEC 822-1203-049	1.0 EA	
472 1724 000	XFMR, PWR CNTL 24V SEC	1.0 EA	T001
542 1006 000	RES 5.4 OHM 766W 10%	3.0 EA	R001 R002 R003
560 0054 000	MOV 4500A 25J 95 VAC	1.0 EA	R010
570 0345 000	CONTACTOR 3 POLE VACUUM	1.0 EA	K003
570 0346 000	CONTACTOR, 3 POLE 190A	1.0 EA	K002
570 0347 000	CONTACTOR, 3 POLE 65A	1.0 EA	K001
574 0405 000	RELAY 3PDT 120VAC 50/60HZ	1.0 EA	K004
604 0991 000	SW, PB, MOM, SPDT	1.0 EA	S004
604 1207 000	SWITCH, DISCONNECT	1.0 EA	S005
606 0953 000	CKT BREAKER 15A 3 POLE	1.0 EA	Q003
606 0954 000	CKT BREAKER 30A 3 POLE	1.0 EA	Q002
606 0955 000	OPERATOR, ELECT; CKT BREAKER	1.0 EA	M001 #Q001
606 0972 000	CKT BREAKER, MICRO CTLR, 3POLE	1.0 EA	Q001
612 1406 000	HOUSING, CAP 3 CKT	1.0 EA	#X007
614 0835 000	PWR DISTRIBUTION BLOCK	1.0 EA	X004
614 0836 000	PWR DISTRIBUTION BLOCK	2.0 EA	X001 X002
614 0917 000	TERM BLK, 3C MODULAR 280	5.0 EA	X6-1 X6-2 X6-3 X6-4 X6-5
614 0921 010	MARKER STRIP, TERM BLK, 1-10	1.0 EA	#X006
817 2336 016	RUNNING LIST,LINE CONTROL	0.0 EA	
839 8205 044	SCH, MOTORIZED BREAKER CKT	0.0 EA	
917 2336 019	CABLE W1 LINE CONTROL CAB	1.0 EA	
992 8724 004	FAB PKG, LINE CONTROL CAB	1.0 EA	
992 8817 001	SOLID STATE RELAY ASSY	1.0 EA	A001
992 9882 001	PWA, REMOTE SHUNT RESET FOR	1.0 EA	A3
999 2787 001	WIRE/TUBING LIST. BASIC	1.0 EA	

WARNING: Disconnect primary power prior to servicing.

Table 7-8. SOLID STATE RELAY ASSY - 992 8817 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (a)*
336 1198 000	SCREW 6-32 X 1/4	4.0 EA	
610 1103 000	HEADER FOR OCTAL SOCKET	1.0 EA	X001
839 8121 030	SCHEM, SOLID STATE RELAY	0.0 EA	
922 1206 018	COVER, SS RELAY	1.0 EA	
939 8121 063	CHASSIS, SS RELAY	1.0 EA	
992 8818 001	PC BD ASSY, SOLID STATE	1.0 EA	

Table 7-9. PC BD ASSY, SOLID STATE - 992 8818 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (e)*
354 0309 000	TERM SOLDER	4.0 EA	
380 0805 000	N-MOSFET IRFPC60 ESD	1.0 EA	
382 0624 000	IC, CT6 ESD	1.0 EA	A001
382 1359 000	IC TC4421CPA ESD	1.0 EA	A002
384 0431 000	RECT. 1N4001 ESD	1.0 EA	V002
386 0082 000	ZENER, 1N4744A 15V 1W 5% ESD	1.0 EA	V003
386 0100 000	ZENER, 1N4747A 20V ESD	1.0 EA	V004
404 0673 000	SOCKET 8 PIN DIP (DL)	2.0 EA	XA001 XA002
516 0530 000	CAP .01UF 10% 100V X7R	1.0 EA	C001
522 0531 000	CAP 1UF 50V 20%	1.0 EA	C002
540 0604 000	* RES 510 OHM 2W 5%	1.0 EA	R002
548 2400 201	RES 100 OHM 1/2W 1%	1.0 EA	R006
548 2400 301	RES 1K OHM 1/2W 1%	2.0 EA	R001 R003
548 2400 401	RES 10K OHM 1/2W 1%	2.0 EA	R004 R005
839 8121 030	SCHEM, SOLID STATE RELAY	0.0 EA	
839 8121 031	PWB, SOLID STATE RELAY	1.0 EA	

Table 7-10. PWA, REMOTE SHUNT RESET FOR - 992 9882 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (e)*
358 3383 000	JUMPER, 0.1" LG, 0.125" H	1.0 EA	JP001: INSTALL POS 1—2
380 0773 000	XSTR FET BS170 N-CHL ESD	2.0 EA	Q001 Q002
382 0626 000	IC, 4093B/14093B ESD	1.0 EA	U004
382 0662 000	IC, MC14013BCP CMOS ESD	1.0 EA	U003
382 1070 000	IC, ILQ-1 OPTO-ISOLATOR ESD	1.0 EA	U002
382 1585 000	IC, LM7812 ESD	1.0 EA	U001
384 0597 000	RECT 1N4002 ESD	11.0 EA	CR003 CR004 CR005 CR006 CR007 CR008 CR009 CR010 CR011 CR013 CR014
384 0837 000	TRANSZORB 1N6376 12V 5W ESD	1.0 EA	CR012
384 0903 000	LED, RED, T-1 ESD	1.0 EA	DS002
384 0904 000	LED, GRN, T-1 ESD	2.0 EA	DS001 DS003
384 0967 000	TRANSZORB 33V DIRECTIONAL ESD	2.0 EA	CR001 CR002
404 0674 000	SOCKET 14 PIN DIP (D-L)	2.0 EA	XU003 XU004
404 0675 000	SOCKET IC 16 CONT	1.0 EA	XU002
516 0435 000	CAP .05UF 100V 20%	1.0 EA	C006
516 0453 000	CAP .1UF 100V 20% X7R	3.0 EA	C002 C003 C004
516 0530 000	CAP .01UF 10% 100V X7R	4.0 EA	C007 C008 C009 C010
522 0548 000	CAP 10UF 50V 20%	3.0 EA	C005 C011 C012
522 0574 000	CAP 22UF 50V 20%	1.0 EA	C001
548 2400 269	RES 511 OHM 1/2W 1%	2.0 EA	R014 R015
548 2400 301	RES 1K OHM 1/2W 1%	7.0 EA	R001 R002 R003 R004 R005 R006 R007
548 2400 368	RES 4.99K OHM 1/2W 1%	5.0 EA	R009 R010 R011

			R012 R013
548 2400 401	RES 10K OHM 1/2W 1%	2.0 EA	R016 R017
548 2400 468	RES 49.9K OHM 1/2W 1%	2.0 EA	R018 R019
548 2400 630	RES 2MEG OHM 1/2W 1%	1.0 EA	R008
574 0497 000	RELAY 2PDT 24VDC 2AMP	2.0 EA	K001 K002
614 0745 000	TERM BD 12C 1ROW PC MT	1.0 EA	TB001
843 5466 771	SCH, REMOTE SHUNT RESET	0.0 EA	
843 5466 773	PWB, REMOTE SHUNT RESET	1.0 EA	

Table 7-11. KIT, SPARES, LINE CONTROL CAB - 994 9797 013

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (c)*
384 0859 000	LED RED CART 24V ESD	1.0 EA	
384 0860 000	LED GREEN CART 24V ESD	3.0 EA	
398 0368 000	FUSE, CART 2A 600V	3.0 EA	
442 0123 000	THERMOSTAT 155 DEG F N.C.	3.0 EA	
472 1724 000	XFMR, PWR CNTL 24V SEC	1.0 EA	
542 1006 000	RES 5.4 OHM 766W 10%	3.0 EA	
560 0054 000	MOV 4500A 25J 95 VAC	1.0 EA	
570 0345 000	CONTACTOR 3 POLE VACUUM	1.0 EA	
570 0346 000	CONTACTOR, 3 POLE 190A	1.0 EA	
570 0347 000	CONTACTOR, 3 POLE 65A	1.0 EA	
574 0405 000	RELAY 3PDT 120VAC 50/60HZ	1.0 EA	
574 0498 000	RELAY, PHASE PROTECTION	1.0 EA	
604 0991 000	SW, PB, MOM, SPDT	1.0 EA	
604 1207 000	SWITCH, DISCONNECT	1.0 EA	
606 0953 000	CKT BREAKER 15A 3 POLE	1.0 EA	
606 0954 000	CKT BREAKER 30A 3 POLE	1.0 EA	
606 0955 000	OPERATOR, ELECT; CKT BREAKER	1.0 EA	
606 0972 000	CKT BREAKER, MICRO CTLR, 3POLE	1.0 EA	
992 8817 001	SOLID STATE RELAY ASSY	1.0 EA	
992 9882 001	PWA, REMOTE SHUNT RESET FOR	1.0 EA	

Table 7-12. CALORIMETRY ASSEMBLY - 992 8812 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (c)*
003 8020 040	CU, TBG 1.0 NOM DIA	21.0 FT	
003 8020 050	CU, TBG 1.5 NOM DIA	5.250 FT	
086 0004 038	SOLDER, SILVER SIZE 0.062	1.0 LB	
086 0004 040	* STAY CLEAN FLUX	1.0 EA	
299 0018 000	THREAD-TAPE, TEFLON	1.0 RL	
358 2765 000	HYDROMETER	1.0 EA	
358 2766 000	HYDROMETER	1.0 EA	
358 2767 000	CYLINDER,HYDROMETER	1.0 EA	
358 3348 000	HOSE CAP, 3/4 HOSE THD.	1.0 EA	
359 0192 000	ELBOW, 90 DEG 1" CXC	6.0 EA	
359 0230 000	TEE 1.5"C X 1.5"C X 1.0"C	3.0 EA	
359 0270 000	ADAPTER, FEMALE	1.0 EA	
359 0324 000	VALVE GLOBE 1" CXC BRONZE	1.0 EA	
359 0435 000	UNION C X M 1-1/2 IN	2.0 EA	
359 0890 000	ELBOW 90 DEG 1-1/2 X 1	2.0 EA	
359 0891 000	TEE, 1 X 1/8 X 1	2.0 EA	
359 0999 000	BOILER DRAIN VALVE	1.0 EA	
359 1010 000	TEE, 1-1/2 X 1-1/2 X 3/4	1.0 EA	

442 0092 000	PROBE, TEMP 300 DEG F MAX	2.0 EA
442 0093 000	THERMISTOR CABLE EXT 50’	2.0 EA
442 0109 000	THERM DGTL -40 DEG F TO	1.0 EA
629 0036 000	ROTAMETER	1.0 EA
646 1488 000	LABEL, CAUTION	1.0 EA
843 5396 160	ASSY INSTR, CALORIMETRY	0.0 EA

Table 7-13. KIT, INSTALLATION, 4" LINE - 992 9139 012

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (g)*
041 1310 013	RUBBER SPONGE 3/8	4.0 FT	#PIPE HANGERS
086 0004 038	SOLDER, SILVER SIZE 0.062	1.0 LB	
086 0004 040	* STAY CLEAN FLUX	1.0 EA	
086 0004 060	SOLDER, HARD SILVER, 1/16DIA	1.80 TZ	
302 0318 000	SCR, 3/8-16 X 1.0	100.0 EA	
302 0319 000	SCR, 3/8-16 X 1-1/4	0.0 EA	
302 0320 000	SCR, 3/8-16 X 1-1/2	100.0 EA	
302 0338 000	SCR, 1/2-13 X 1-1/2	100.0 EA	
306 0034 000	NUT, HEX 1/2-13	130.0 EA	
306 0047 000	NUT, HEX 3/8-16	130.0 EA	
310 0011 000	WASHER, FLAT 3/8	150.0 EA	
310 0026 000	WASHER, FLAT 1/2	150.0 EA	
314 0011 000	WASHER, SPLIT-LOCK 3/8	150.0 EA	
314 0015 000	WASHER, SPLIT-LOCK 1/2	150.0 EA	
358 1127 000	ANGLE FITTING 90 DEG	15.0 EA	
358 1131 000	NUT W/SPRING 3/8-16	60.0 EA	
358 1891 000	ANCHOR SCREW 3/8-16	0.0 EA	
358 1895 000	NUT W/SPRING 1/2-13	20.0 EA	
358 1896 000	ROD 1/2-13 THREADED	12.0 EA	
358 2160 000	CHANNEL 1-5/8 SQ 20 FT LG	6.0 EA	
358 2188 000	FLAT PLATE FITTING	40.0 EA	
358 2202 000	NUT COUPLER 3/8-16	5.0 EA	
358 2472 000	FLAT PLATE FITTING	10.0 EA	
358 3038 000	HOSE BARB 1" H X 1" MPT	2.0 EA	
358 3564 000	CLAMP, PIPING, WITH CUSHION	14.0 EA	
358 3598 000	ANGLE, UNISTRUT, 45 DEGREE	2.0 EA	
358 3700 000	CLAMP, PIPING, WITH CUSHION	8.0 EA	
359 1049 000	PIPE HANGER 2IN LAY-IN	2.0 EA	
359 1051 000	PIPE HANGER 4IN LAY-IN	4.0 EA	
359 1053 000	PIPE HANGER 2.0IN LAY-IN	0.0 EA	
359 1055 000	PIPE HANGER 4.0IN LAY-IN	0.0 EA	
464 0055 000	SETTING TOOL	0.0 EA	
464 0056 000	DRILL MASONARY	0.0 EA	
690 0017 000	PIPE JOINT COMPOUND	1.0 EA	

Table 7-14. ASSY, AUTO-CHANGEOVER CTLR - 992 9508 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (d)*
252 0003 000	WIRE, STRD 20AWG WHT	10.0 FT	
398 0017 000	FUSE, FAST CART 1A 250V	1.0 EA	F001
402 0024 000	FUSE HOLDER	1.0 EA	XF001
439 0011 000	CONTROLLER,AUTOCHANGEOVER	1.0 EA	
604 0395 000	SW, TGL DPDT	1.0 EA	#MANUAL OVERRIDE
614 0102 000	TERM BD 12 TERM	1.0 EA	TB001

751 9621 000	JUNCTION BOX 10X8X4"	1.0 EA	
822 1186 080	INSTR, MODIFIED BOX	0.0 EA	
839 8106 078	WIRING DIAG, UNIT	0.0 EA	
922 1186 079	COVER, FRONT, AUTOCHGOVER UNIT	0.0 EA	
922 1186 081	HINGE AUTO/CHANGEOVER BOX	1.0 EA	
939 8106 081	PLATE MTG AUTO/CHGOVER	1.0 EA	
988 2394 001	DP, PUMP MODULE WITH AUTOMATIC	1.0 EA	

Table 7-15. XMTR-Q, CD70P1/CD100P1 - 994 9648 004

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (w)*
378 0196 000	IOT AND CIRCUIT ASSEMBLY 70KW	0.0 EA	ORDER QTY 1 FOR CD70P1 OR DROP SHIP-MENTS. EEV
378 0198 000	IOT AND CIRCUIT ASSEMBLY 110KW	0.0 EA	ORDER QTY 1 FOR CD100P1 OR DROP SHIPMENTS. EEV
378 0213 000	KLYSTRODE, CDK2750W3	0.0 EA	ORDER QTY 1 FOR CD70P1 OR DROP SHIP-MENTS. CPI
378 0214 000	KLYSTRODE, CDK2110W3	0.0 EA	ORDER QTY 1 FOR CD100P1 OR DROP SHIPMENTS. CPI
3913-466-56810	3DB COUPLER LO POWER BD5	0.0 EA	SELECT ONE FOR 626-860 MHZ
3913-466-59680	*3DB COUPLER LO POWER BD4	0.0 EA	SELECT ONE FOR 470-636 MHZ
432 0393 000	BLOWER REGENERATIVE 2.5HP	0.0 EA	CHOOSE 1 FOR HIGH ALT.
484 0441 000	BREAKAWAY/FILTER, 470-596 MHZ	0.0 EA	ORDER QTY 1 FOR CH 14-34
484 0442 000	BREAKAWAY/FILTER, 596-704 MHZ	0.0 EA	ORDER QTY 1 FOR CH 35-52
484 0443 000	BREAKAWAY/FILTER, 704-862 MHZ	0.0 EA	ORDER QTY 1 FOR CH 53-69
484 0461 000	FILTER, LOW PASS 700MHZ	0.0 EA	ORDER QTY 1 FOR CH 14 TO 43
484 0462 000	FILTER, LOW PASS 1000MHZ	0.0 EA	ORDER QTY 1 FOR CH 44 TO 78
620 2957 008	CIRCULATOR, UHF	0.0 EA	ORDER QTY 2 FOR FEED FWD CH 14-26
620 2957 009	CIRCULATOR, UHF	0.0 EA	ORDER QTY 2 FOR FEED FWD CH 27-44
620 2957 010	CIRCULATOR, UHF	0.0 EA	ORDER QTY 2 FOR FEED FWD CH 45-69
620 2957 011	CIRCULATOR, UHF	0.0 EA	ORDER QTY 2 FOR FEED FWD CH 70-77
620 2974 000	CIRCULATOR, 470-547 MHZ	0.0 EA	ORDER QTY 4 FOR SINGLE IPA, 8 FOR DUAL IPA CH 14-26
620 2975 000	*CIRCULATOR, 537-636 MHZ	0.0 EA	ORDER 4 FOR SINGLE IPA, 8 FOR DUAL IPA, CH 27-40
620 2976 000	*CIRCULATOR, 626-740 MHZ	0.0 EA	ORDER 4 FOR SINGLE IPA, 8 FOR DUAL IPA, CH 41-57
620 2977 000	*CIRCULATOR, 730-860 MHZ	0.0 EA	ORDER 4 FOR SINGLE IPA, 8 FOR DUAL IPA, CH 58-77
917 2300 133	NAMEPLATE, XMTR FCC SERIAL	1.0 EA	
952 9215 136	BLANK PANEL, 6 RACK UNITS	1.0 EA	1 USED IN CONTROL CABINET WITHOUT MODE CONTROL
992 9821 001	CABINET, REAR, SIGMA+	1.0 EA	
992 9822 002	CABINET, FRONT, LINEAR, SIGMA+	1.0 EA	
992 9824 002	CABINET, CONTROL (CD1A)	1.0 EA	
992 9830 002	KIT, EEV FITTINGS	0.0 EA	ORDER 1 FOR EEV TUBES
992 9830 016	KIT, SINGLE IPA	0.0 EA	ORDER QTY 1 WHEN USED WITH EEV 70KW ALL CHANNELS, EEV 100KW CH 26 & LOWER
992 9830 017	KIT, DUAL IPA	0.0 EA	ORDER QTY 1 WHEN USED WITH CPI ALL POWERS & CHANNELS, EEV 100KW CH 27 & UP
992 9830 020	KIT, DUAL EXCITER	0.0 EA	ORDER QTY 1 FOR DUAL EXCITER
992 9830 021	KIT, SINGLE EXCITER	0.0 EA	ORDER QTY 1 FOR SINGLE EXCITER

WARNING: Disconnect primary power prior to servicing.

992 9830 026	KIT, CPI ASSY	0.0 EA	ORDER 1 FOR CPI TUBES
992 9830 027	KIT, ASSY, EEV	0.0 EA	ORDER 1 FOR EEV TUBES
992 9830 030	KIT, CPI FITTINGS	0.0 EA	ORDER 1 FOR CPI TUBES
994 9785 001	EXCITER,CD-1A UHF OR VHF TUNED	0.0 EA	ORDER 1 FOR SINGLE EXCITER, ORDER 2 FOR DUAL EXCITERS QUINCY WILL FORMAT TO CHANNEL

Table 7-16. CABINET, REAR, SIGMA+ - 992 9821 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (ay)*
026 6010 003	GROMMET STRIP, 0.125	3.730 FT	
041 1310 030	GASKET, RUBBER	7.30 FT	
041 6030 010	RUBBER CHANNEL X650	1.050 FT	
2422-137-00057	MAGNET PROXIMITY	2.0 EA	S011 S012
2422-137-00058	SWITCH PROXIMITY SPST N/O	2.0 EA	S011 S012
250 0508 000	CABLE FIBER OPTIC	9.0 EA	
296 0253 000	TUBING, SHRINK 3/16 WHITE	1.50 FT	
302 0141 100	SCR, 10-32 X 3/8	4.0 EA	INTERLOCK SWITCH COVER
302 0143 100	SCR, 10-32 X 1/2	13.0 EA	(5) EARTH SUPPORT, (4) EARTHING ASSY MTG, (4) SWITCH ASSY MTG
302 0144 100	SCR, 10-32 X 5/8	8.0 EA	(4) 8-WAY DUMP LOAD, (4) 3-WAY DUMP LOAD
302 0145 100	SCR, 10-32 X 3/4	4.0 EA	C6 CLAMP
302 0213 100	SCR, 1/4-20 X 1/2	6.0 EA	(2) MULTIPIER PWA MTG, (2) XFMR AD, (2) XFMR AB
302 0215 100	SCR, 1/4-20 X 3/4	6.0 EA	(6) ISO P/S MTG
354 0658 000	TERMINAL PRESSURE	2.0 EA	S011 S012
354 0880 000	SPLICE, CAGE-CLAMP, 20-16AWG	2.0 EA	S011 S012
358 0473 000	CLAMP, HOSE	2.0 EA	
358 2598 000	CABLE TIE MOUNT, 4-WAY	2.0 EA	
358 3434 000	TY-RAP MTG BASE .316" TIE	4.0 EA	
359 1202 000	NIPPLE 1.5 NPT X 2.5 L	2.0 EA	INT AIR
424 0003 000	GROMMET 1/2 MTG DIA	1.0 EA	
424 0586 000	HOSE BLACK 2" ID	8.0 FT	
426 0077 000	ISOLATION MOUNT	4.0 EA	INT AIR
432 0392 000	BLOWER REGENERATIVE 1HP	1.0 EA	INT AIR
448 0986 000	FILTER,HIGH EFF,STYLE 192	1.0 EA	INT AIR
472 1710 000	XFMR, FIL 8.9V 33A SEC	1.0 EA	
472 1711 000	XFMR, FIL 6.4V 30A SEC	1.0 EA	
472 1771 000	*XFMR, GRID BIAS & ION PUMP	1.0 EA	
508 0581 000	CAP 0.05UF 2000A	1.0 EA	C006
540 1217 000	RES 22.0 OHM 50W 10%	1.0 EA	R011
542 1656 000	RES 4.7 OHM 12W 5%	1.0 EA	
552 0999 000	RHEO, DUAL 50 OHM, 100W	1.0 EA	R005
604 1044 000	SW, INTLK DPDT	3.0 EA	S001 S002 S003
650 0304 000	LEVER, HANDLE BLACK 80MM	1.0 EA	
839 7900 073	BRKT, INTERLOCK	3.0 EA	
913 5001 107	STANDOFF HEX 1/4-20 X	4.0 EA	
917 2462 054	SLUG, CORONA REDUCER	4.0 EA	
917 2462 057	CABLE, GROUND	1.0 EA	CROWBAR
917 2506 014	ADAPTOR	3.0 EA	
917 2506 035	CABLE, PA REAR CABINET	1.0 EA	
917 2506 050	STANDOFF	2.0 EA	
917 2506 054	CONNECTOR, BACKPLANE	4.0 EA	

WARNING: Disconnect primary power prior to servicing.

917 2506 084	STANDOFF, HEATSINK MTG	4.0 EA	HEATSINK MTG
917 2506 103	CLIP, 1" RESISTOR, .25 DIA MTG	1.0 EA	CROWBAR
922 1297 022	CLAMP	1.0 EA	
922 1297 032	COVER, SWITCH HOUSING	2.0 EA	
922 1297 033	SPACER	4.0 EA	
922 1297 035	SEAL POT MTG	1.0 EA	
922 1297 044	PILLAR EARTHING	2.0 EA	
922 1297 045	PILLAR, ISOLATED	6.0 EA	
922 1297 056	PLATE	1.0 EA	
939 8205 016	SUPPORT	1.0 EA	
939 8205 017	SEAL BOTTOM REAR	2.0 EA	
939 8205 018	SEAL TOP REAR	3.0 EA	
939 8205 021	TRANSIT BLOCK ISO PWR SUPPLY	2.0 EA	
939 8205 022	COVER, BODY, CURRENT MONITOR	1.0 EA	
939 8205 025	HOUSING, SWITCH	2.0 EA	
939 8205 031	PLATE, SUPPORT	1.0 EA	
939 8205 036	CLAMP	2.0 EA	
943 5496 044	PLATE	1.0 EA	INT AIR
943 5496 045	CLAMP	1.0 EA	INT AIR
943 5496 051	ASSY, HOUSING	1.0 EA	INT AIR
952 9215 002	SYSTEM, INTERLOCK & EARTHING	1.0 EA	
952 9215 057	ASSY, CAB, WELDMENT REAR	1.0 EA	
952 9215 067	STRAP	1.0 EA	
952 9215 068	STRAP	1.0 EA	
952 9215 069	STRAP	1.0 EA	
952 9215 070	PLATE EARTHING SUPPORT	1.0 EA	
952 9215 071	PANEL RIGHT DIVIDE REAR	1.0 EA	
952 9215 073	PANEL, RIGHT, REAR CABINET	1.0 EA	
952 9215 074	PANEL, LEFT, REAR CABINET	1.0 EA	
952 9215 082	STRAP	1.0 EA	
952 9215 083	STRAP	1.0 EA	
952 9215 118	FOAM, REAR CABINET	4.0 EA	
952 9215 175	PANEL LEFT DIVIDE REAR	1.0 EA	
992 8744 001	BODY CURRENT MONITORING	1.0 EA	
992 9087 001	*PWA, METER MULTIPLYER	1.0 EA	
992 9737 103	*ASSY, 8-WAY DUMP LOAD	1.0 EA	OBTAIN B/M FROM CAMBRIDGE
992 9825 001	ASSY, CROWBAR, SIGMA+	1.0 EA	
992 9830 001	ASSEMBLY, SWITCH	1.0 EA	
992 9883 004	KIT, EARTH WAND	1.0 EA	
992 9883 007	ASSY, HOUSING	2.0 EA	
992 9883 008	ASSY, REAR DOOR	2.0 EA	
992 9883 009	ASSY, WINDOW	1.0 EA	
992 9883 010	ASSY, REAR DOOR W/WINDOW	1.0 EA	

Table 7-17. BODY CURRENT MONITORING - 992 8744 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (b)*
296 0253 000	TUBING, SHRINK 3/16 WHITE	0.130 FT	
296 0310 000	TUBING TEFLON 20 AWG	0.160 FT	
354 0050 000	LUG 10 MTG HOLE	1.0 EA	
354 0140 000	LUG SLDR .25 HOLE	1.0 EA	
358 3134 000	STUD, BRS 1/4-20 X 1-3/4	1.0 EA	
358 3136 000	STUD, BRS 1/4-20 X 2-1/4	1.0 EA	
358 3434 000	TY-RAP MTG BASE .316" TIE	4.0 EA	
384 0614 000	RECT 70HF40	1.0 EA	

WARNING: Disconnect primary power prior to servicing.

384 0674 000	RECTIFIER 70A 400 PIV ESD	1.0 EA
402 0001 000	CLIP, FUSE 1.062 60A 600V	2.0 EA
506 0275 000	CAP 1UF 250V 20%	1.0 EA
522 0326 000	CAP 100UF 50V 20%	1.0 EA
522 0616 000	CAP 6800UF 50V ELECT	1.0 EA
542 1628 000	RES 1 OHM 10% 180W W/W	1.0 EA
638 0030 000	SHUNT 5A 75MV CLASS 1.0	1.0 EA
917 2506 048	STANDOFF, ISO PWR SUPPLY	2.0 EA
917 2506 116	STANDOFF, .75 DIA X 1.3L, G10	2.0 EA
917 2506 117	CABLE, BODY/COLLECTOR	1.0 EA
939 8121 059	PLATE	1.0 EA

Table 7-18. ASSY, CROWBAR, SIGMA+ - 992 9825 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (t)*
302 0141 100	SCR, 10-32 X 3/8	7.0 EA	(3) CORONA SHIELD, (4) FDUZ SCREEN
302 0143 100	SCR, 10-32 X 1/2	3.0 EA	THYRATRON/STANDOFF
302 0213 100	SCR, 1/4-20 X 1/2	2.0 EA	(1) RESISTOR/ POST, (1) SHIELD MTG ANGLE
302 0214 100	SCR, 1/4-20 X 5/8	4.0 EA	(1) POST/MTG BRACKET, (1) XFMR/ANGLE, (2) CATHODE
302 0215 100	SCR, 1/4-20 X 3/4	5.0 EA	(1) HV-VE INPUT, (4) POST/MTG BRACKET
354 0002 000	LUG, #8 RING RED 22-18AWG	2.0 EA	
354 0004 000	LUG .25 RING RED 22-18AWG	2.0 EA	
354 0140 000	LUG SLDR .25 HOLE	4.0 EA	
354 0145 000	LUG SHAKE .150 MTG	1.0 EA	
354 0146 000	LUG SHAKE .176 MTG	4.0 EA	
354 0325 000	LUG,.25 RING YEL 12-10AWG	2.0 EA	
354 0669 000	TERM 250 FEM RED 22-18	4.0 EA	
354 0728 000	TERM, 110 FEM RED 22-18	2.0 EA	
358 2598 000	CABLE TIE MOUNT, 4-WAY	1.0 EA	
358 3455 000	STANDOFFS, HEX, 3/8	3.0 EA	
378 0170 000	THYRATRON, CERAMIC	1.0 EA	
402 0003 000	CLIP, FUSE .562 30A 250V	4.0 EA	
402 0200 000	CLIP FUSE 1 INCH	5.0 EA	
424 0012 000	GROMMET 1/4 MTG DIA	1.0 EA	
424 0023 000	GROMMET 1 IN MTG DIA	2.0 EA	
430 0234 000	FAN 12VDC 80MM	1.0 EA	U001
442 0132 000	SWITCH, THERMAL, NO	1.0 EA	S001
472 1730 000	XFMR, CURRENT 60 TURN CT1	1.0 EA	CT001
472 1738 000	XFMR STEP-UP 50/60HZ	1.0 EA	T002
516 0074 000	CAP, DISC .005UF 1KV 20%	1.0 EA	C005 USED ON METER
516 0562 000	CAP, 2200PF 6000V	3.0 EA	C002 C003 C004
516 0986 000	CAP, 460PF 30KV +80/-20%	1.0 EA	C001
540 1541 000	RES 40 OHM 75W 20% 8"X1"D	2.0 EA	R007 R008
540 1600 001	RES 1 OHM 3W 5%	1.0 EA	R012
542 1636 000	RES 100 OHM 12W 5%	2.0 EA	R009 R010
542 1638 000	RES 470 OHM 12W 5%	1.0 EA	R005
542 1645 000	RES 22 OHM 2.5W 5%	1.0 EA	R002
542 1646 000	RES 33 OHM 2.5W 5%	1.0 EA	R001
542 1648 000	RES 100 OHM 2.5W 5%	1.0 EA	R006
546 0324 000	RES, 25 MEG 45KV 23W 10%	2.0 EA	R003 R004
612 1451 000	FEMALE CONNECTOR, 4C	1.0 EA	
612 1477 000	CONNECTOR, FEMALE, 2C,	1.0 EA	

WARNING: Disconnect primary power prior to servicing.

612 1528 000	PLUG, FEMALE, 3C STRAIGHT	1.0 EA	
614 0159 000	TERM STRIP 3 TERM	1.0 EA	
620 2973 000	JACK, ISOLATED BULKHEAD, BNC	1.0 EA	
632 1203 000	METER TO SPEC, 0-10V	1.0 EA	M001
843 5496 039	SCHEMATIC, CROWBAR ASSEMBLY	0.0 EA	
917 2462 053	DISC, CORONA REDUCER	2.0 EA	
917 2462 055	ANGLE, CORONA SHIELD MTG	3.0 EA	
917 2506 026	STUD	1.0 EA	
917 2506 027	BUSHING	2.0 EA	
917 2506 028	STUD	2.0 EA	
917 2506 030	ANGLE TEMP SENSOR MTG	1.0 EA	
917 2506 032	PLATE CORONA SHIELD	1.0 EA	
922 1297 039	CORONA BUSTER CROWBAR	1.0 EA	
922 1297 040	CORONA BUSTER	1.0 EA	
939 8205 032	POST	1.0 EA	
939 8205 033	POST	2.0 EA	
939 8205 034	POST	1.0 EA	
939 8205 035	ANGLE	1.0 EA	
939 8205 038	POST	1.0 EA	
943 5496 031	MTG BRACKET	1.0 EA	
943 5496 032	SCREEN	1.0 EA	
943 5496 033	PLINTH	1.0 EA	
952 9202 160	BRACKET, RESISTOR MTG	1.0 EA	
992 8748 002	*PWA, THYROTRON INTERFACE	1.0 EA	
992 8815 002	*PWA, IOT FDU2	1.0 EA	
999 2903 001	WIRE/TUBING LIST, CROWBAR,	1.0 EA	

Table 7-19. ASSEMBLY, SWITCH - 992 9830 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (f)*
302 0510 000	SCR, 1/4-20 X 1-1/2	1.0 EA	
3913-463-13670	*SPRING, TENSION	1.0 EA	
3913-467-02300	*LOCK, MODIFIED	1.0 EA	
598 0461 000	ACTUATOR MICRO/SW ROLLER	1.0 EA	
604 1168 000	SW MICRO 1POL 10A	2.0 EA	
917 2506 051	BAR, LOCKING, SWITCH ASSY	1.0 EA	
917 2506 052	LEVER, SWTICH ASSY	1.0 EA	
917 2506 053	PILLAR, SWITCH ASSY	1.0 EA	
939 8205 026	SWITCH SUPPORT	1.0 EA	

Table 7-20. ASSY, HOUSING - 992 9883 007

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (e)*
350 0037 000	RIVET POP .125X.265	20.0 EA	
430 0241 000	FAN GUARD	1.0 EA	
430 0242 000	FAN 230V A/C 50/60HZ	1.0 EA	
922 1297 041	FILTER	2.0 EA	
939 8205 024	SEAL REAR	1.0 EA	
952 9215 077	MOUNT, FILTER HOUSING ASSY	1.0 EA	
952 9215 078	GUARD, FILTER HOUSING ASSY	1.0 EA	
952 9215 079	PLATE, FILTER HOUSING ASSY	1.0 EA	
952 9215 080	PANEL, FILTER HOUSING ASSY	1.0 EA	

Table 7-21. CABINET, FRONT, LINEAR, SIGMA+ - 992 9822 002

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (am)*
026 6010 003	GROMMET STRIP, 0.125	4.0 FT	
041 1310 030	GASKET, RUBBER	2.0 FT	
2413-015-11064	CLIP EARTH ADJ 12-32MM	3.0 EA	
296 0344 000	TUBG, POLYETHYLENE 1/4 OD	4.0 FT	CUT 3 FOOT AND 1 FOOT
357 0089 000	GUIDE, MODULE	2.0 EA	
358 0473 000	CLAMP, HOSE	4.0 EA	
358 2598 000	CABLE TIE MOUNT, 4-WAY	2.0 EA	
358 2628 000	CABLE PUSH MOUNT	6.0 EA	
358 2635 000	CABLE TIE, PUSH MOUNT SNAP IN	6.0 EA	
358 2995 000	END PLATE, 261 TERM BD	1.0 EA	
358 2996 000	END PLATE, 262 TERM BD	1.0 EA	
358 3385 000	PIN QUICK RELEASE 1/4X4.0	2.0 EA	
358 3490 000	END STOP, 264 TERM BLOCK	2.0 EA	#TB012
358 3491 000	END PLATE, 264 TERM BLOCK	1.0 EA	#TB012
359 0180 000	ELBOW MALE 90 DEG	2.0 EA	
396 0252 000	LAMP, 28V 0.17 AMP +/-10%	4.0 EA	
406 0525 000	LAMPHOLDER, BAYONET BASE	4.0 EA	
424 0005 000	GROMMET 3/4 MTG DIA	1.0 EA	
424 0006 000	GROMMET 13/16 MTG DI	2.0 EA	
424 0022 000	GROMMET 3/4 MTG DIA	1.0 EA	
430 0031 000	FAN CARAVEL CL3T2/020191	2.0 EA	ROOF FLUSHING
430 0190 000	FAN GUARD 10"	2.0 EA	ROOF FLUSHING
448 1026 000	HINGE, METAL LIFT-OFF	4.0 EA	
448 1125 000	LATCH, RAISED, ADJ LEVER	2.0 EA	
522 0529 000	CAP 470UF 50V 20%	1.0 EA	
548 2400 151	RES 33.2 OHM 1/2W 1%	1.0 EA	
552 0999 000	RHEO, DUAL 50 OHM, 100W	2.0 EA	R002, R003
552 1000 000	RHEOSTAT, TANDEM 150 OHM	1.0 EA	R001
604 0447 000	SW, PRESS.	1.0 EA	IOT AIR S007
604 1005 000	SW, AIR PRESSURE	1.0 EA	IPA AIR S006
604 1154 000	THERMOSWITCH NC 70 DEG C	2.0 EA	S004 S005
614 0787 000	TERM BD, 4C MODULAR 261	2.0 EA	
614 0789 000	TERM BD, 4C MODULAR 262	2.0 EA	
614 0892 000	TERM BLOCK, 4C RAIL MNT	8.0 EA	#TB012
646 1253 201	LABEL, WARNING	2.0 EA	
646 1483 000	HARRIS NAMEPLATE	1.0 EA	
917 2413 350	CARRIER RAIL, 4.6"	1.0 EA	#TB012
917 2506 009	SPACER FRONT	4.0 EA	
917 2506 010	SPACER HU METERS	6.0 EA	
917 2506 036	HANGER, INPUT BOX	1.0 EA	
917 2506 039	CLAMP, PLUMBING	8.0 EA	
917 2506 067	CABLE, AC DISTRIBUTION LINEAR	1.0 EA	
917 2506 068	CABLE, PA FRONT LINEAR	1.0 EA	
922 1297 009	BLOCK, DOOR PIVOT	1.0 EA	
922 1297 021	ASSY, SPIGOT DOOR PIN	2.0 EA	
939 8205 001	FOAM, SIDE PANELS	4.0 EA	
939 8205 006	WASHER PLATE	1.0 EA	
939 8205 007	WEDGE LOCATOR	2.0 EA	
939 8205 008	BRACKET, LOCATOR	1.0 EA	
939 8205 009	SEAL BTM RIGHT	1.0 EA	
939 8205 010	SEAL BTM LEFT	1.0 EA	
939 8205 011	SEAL TOP LEFT	1.0 EA	
939 8205 012	SEAL TOP RIGHT	1.0 EA	

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939 8205 040	SUPPORT, MTG, PLUMBING	2.0 EA	
939 8205 064	CLAMP, IPA	1.0 EA	
943 5496 019	COVER HU METERS	1.0 EA	
943 5496 020	WINDOW HU METERS	1.0 EA	
943 5496 022	TRIM FRONT	1.0 EA	
943 5496 023	TROLLY STOP FRONT	1.0 EA	
943 5496 036	ASSY, PLUMBING W/GATE VALVES	1.0 EA	
943 5496 055	SHIELD, POT	1.0 EA	
943 5496 056	ENCLOSURE, I/O	1.0 EA	
943 5496 059	COVER, I/O	1.0 EA	
943 5496 060	CLOSE-OUT, I/O	1.0 EA	
952 9215 030	BLANK PANEL, 4 RACK UNITS	1.0 EA	
952 9215 040	ASSY, WELDMENT, FRONT CAB	1.0 EA	
952 9215 047	PANEL RIGHT	1.0 EA	
952 9215 049	SHELF LOWER	1.0 EA	
952 9215 050	BOX HU METERS	1.0 EA	
952 9215 054	STRAP	1.0 EA	
952 9215 055	STRAP	1.0 EA	
952 9215 153	ANGLE, LEFT	1.0 EA	
952 9215 154	PANEL CENTER	1.0 EA	
952 9215 155	PANEL, LEFT	1.0 EA	
952 9215 176	SHELF UPPER, DUAL IPA	1.0 EA	
952 9215 179	COVER, CB DOOR	1.0 EA	
992 8734 001	*MODULE, 1KW S.S. AMPLIFIER	1.0 EA	
992 9384 001	*PWA, IOT 2 INTERFACE	1.0 EA	
992 9476 001	*EMI FILTER	1.0 EA	
992 9478 119	*KIT,MOD RF MUTE RELAY(CFSB81)	1.0 EA	MR
992 9830 011	COOLING, IPA	1.0 EA	
992 9830 012	ASSY, CONTROL P/S UNIT	1.0 EA	
992 9830 015	ASSY, BASIC FEED FWD	1.0 EA	
992 9830 019	KIT, BOOST AMP	1.0 EA	
992 9883 004	KIT, EARTH WAND	1.0 EA	
992 9883 005	ASSY, DOOR RIGHT FRONT	1.0 EA	
992 9883 006	ASSY, DOOR, LEFT FRONT	1.0 EA	
992 9883 014	ASSY, FOCUS POWER SUPPLY	1.0 EA	
992 9883 015	ASSY, IPA POWER SUPPLY	1.0 EA	
992 9883 016	CONTACTOR/CIRCUIT BREAKER DOOR	1.0 EA	
992 9883 017	ASSY, SW METER/LINEARIZER	1.0 EA	
992 9883 018	CONTROL & MONITORING(SIGMA CD)	1.0 EA	
992 9883 019	ASSY, TERM BLK CUSTOMER INTFC	1.0 EA	

Table 7-22. COOLING, IPA - 992 9830 011

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (f)*
041 1310 030	GASKET, RUBBER	3.1670 FT	
296 0262 000	TUBING, SHRINK 1/4 WHITE	0.1670 FT	
358 3466 000	END PLATE W/FIXING FLANGE	1.0 EA	
426 0081 000	MOUNT, ANTI-VIBRATION (METRIC)	4.0 EA	
430 0241 000	FAN GUARD	1.0 EA	
430 0251 000	FAN CENTRIFUGAL	1.0 EA	
614 0885 000	MODULAR TERMINAL BLOCK	1.0 EA	
614 0886 000	MODULAR TERMINAL BLOCK 4C	3.0 EA	
646 0665 000	INSPECTION LABEL	1.0 EA	
939 8121 928	BRACKET, FAN MOUNTING	1.0 EA	
939 8205 062	SUPPORT, IPA COOLING	2.0 EA	

952 9215 177	BOX, IPA COOLING	1.0 EA
952 9215 178	LID, IPA COOLING	1.0 EA
999 2916 001	HARDWARE LIST, COOLING IPA	1.0 EA

Table 7-23. ASSY, CONTROL P/S UNIT - 992 9830 012

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (c)*
254 0002 000	WIRE, BUS CU 20AWG	0.10 FT	
358 3466 000	END PLATE W/FIXING FLANGE	1.0 EA	
560 0111 000	VARISTOR 275VAC 140J 275VRMS	3.0 EA	
610 1248 000	MALE CONNECTOR, 8C,	1.0 EA	
614 0885 000	MODULAR TERMINAL BLOCK	1.0 EA	
614 0886 000	MODULAR TERMINAL BLOCK 4C	3.0 EA	
736 0311 000	POWER SUPPLY LINEAR	1.0 EA	
917 2506 080	JUMPER PACKAGE, CTLR P/S	1.0 EA	
943 5496 054	SHELF, CONTROL P/S UNIT	1.0 EA	
943 5496 057	COVER, CONTROL P/S UNIT	1.0 EA	

Table 7-24. ASSY, BASIC FEED FWD - 992 9830 015

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (h)*
358 3434 000	TY-RAP MTG BASE .316" TIE	1.0 EA	TUNER SUPPORT
618 0757 000	LINE STRETCHER 8" TRAVEL	2.0 EA	PH001, PH002
620 0118 000	ADAPTOR N UG57B/U	2.0 EA	
620 0122 000	ADAPTER, N-PLUG/N-JACK, RT ANG	1.0 EA	
620 2868 000	COUPLER DIRECTIONAL 450-860MHZ	1.0 EA	HB002
646 0665 000	INSPECTION LABEL	1.0 EA	
917 2506 042	COAX PKG, FEED FORWARD	1.0 EA	
917 2506 045	CLAMP, 3DB COUPLER	1.0 EA	
917 2506 105	BRACKET, TUNER SUPPORT	1.0 EA	TUNER SUPPORT
939 8121 253	*ASSY, DUAL PROBE, IOT	1.0 EA	U002
939 8205 071	PLATE, CIRCULATOR MTG	2.0 EA	
939 8205 072	PLATE, INNER MTG	1.0 EA	
939 8205 073	SPACER, CIRCULATOR	2.0 EA	
939 8205 076	PLATE, 6DB MOUNTING	1.0 EA	
939 8205 078	ANGLE, COUPLER MTG	1.0 EA	
943 5396 405	*SINGLE-PROBE IOT	1.0 EA	U001
952 9215 189	SUPPORT BASE, FEED FORWARD	1.0 EA	
992 9737 102	*ASSY, 40 WATT AMP, SIGMA++	1.0 EA	OBTAIN B/M FROM CAMBRIDGE
992 9800 001	PWA, FEED FORWARD REF AMP	1.0 EA	
999 2919 001	HARDWARE LIST, BASIC FEED FWD	0.0 EA	

Table 7-25. PWA, FEED FORWARD REF AMP - 992 9800 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (f)*
007 4060 084	BRZ, PH FGR STOCK	2.0 EA	
055 0100 005	*THERMAL COMPOUND, 8OZ JAR	0.0 EA	
086 0001 002	*SEALANT, MEDIUM STRENGTH	0.0 EA	
300 1537 000	SCR, 6-32 X 5/16	4.0 EA	R009 R011 R012 R014
302 0012 000	SCR, 2-56 X 1/4	4.0 EA	2/J002 2/J003
302 0105 000	SCR, 6-32 X 5/16	6.0 EA	2/PCB 4/COVER
302 0110 000	SCR, 6-32 X 3/4	4.0 EA	2/U003 2/U004
302 0441 000	SCR, 4-40 X 3/8	2.0 EA	2/J001
310 0012 000	WASHER FLAT 6	6.0 EA	2/PCB

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312 0047 000	WASHER, SPLIT-LOCK 6	4.0 EA	R009 R011 R012 R014
314 0001 000	WASHER, SPLIT-LOCK 2	4.0 EA	2/J002 2/J003
314 0003 000	WASHER, SPLIT-LOCK 4	2.0 EA	2/J001
314 0005 000	WASHER, SPLIT-LOCK 6	10.0 EA	2/PCB 4/COVER 2/U003 2/U004
328 0033 000	WASHER FLAT STEEL	1.0 EA	
358 1214 000	SCREWLOCK, FEMALE	1.0 EA	
358 3406 000	STANDOFF, 6-32 X 7/8"	4.0 EA	4/PCB
382 1400 000	IC, CA5800 ESD	2.0 EA	U003 U004
494 0218 000	CHOKE WIDE BAND	2.0 EA	RFC001 RFC002
544 1677 000	RES, 270 OHM, 20W, 2%	1.0 EA	R009
544 1678 000	RES, 90 OHM, 20W, 2%	2.0 EA	R011 R012
544 1679 000	RES, 5 OHM, 20W, 2%	1.0 EA	R014
550 0932 000	POT 5K OHM 2W 10%	1.0 EA	R005
610 1288 000	PLUG 9 PIN	1.0 EA	J001
620 2944 000	RECEPTACLE, SMA FLANGE MOUNT	2.0 EA	J002 J003
646 0665 000	INSPECTION LABEL	1.0 EA	
952 9202 139	BASE FEED FORWARD AMP	1.0 EA	
952 9202 140	BOX FEED FORWARD AMP	1.0 EA	
992 9800 002	PWA, FEED FORWARD AMP SMT	1.0 EA	

Table 7-26. PWA, FEED FORWARD AMP SMT - 992 9800 002

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (c)*
382 1608 000	IC, ERA-5SM ESD	1.0 EA	U002
383 0313 000	ATTENUATOR DC CONTROL ESD	1.0 EA	U001
496 0013 000	IND CHIP .100 UH 10%	1.0 EA	L001
515 0046 000	*CAP 100PF 50V 5% 1206 COG	6.0 EA	C002 C004 C005 C006 C011 C012
515 0052 000	*CAP 330PF 50V 5% 1206 COG	1.0 EA	C003
515 0084 000	*CAP .01UF 50V 10% 1206 X7R	1.0 EA	C014
515 0137 501	CAP 0.1UF 50V 10% 1206 X7R	2.0 EA	C007 C008
523 0003 101	CAP 10UF 35V 20% SMT	4.0 EA	C001 C009 C010 C013
545 0309 118	RES 51.1 OHM 1% 1/4W 1206	1.0 EA	R007
545 0309 201	RES 100 OHM 1% 1/4W 1206	2.0 EA	R010 R013
545 0309 211	RES 267 OHM 1% 1/4W 1206	1.0 EA	R006
545 0309 218	RES 511 OHM 1% 1/4W 1206	1.0 EA	R008
545 0309 305	RES 1.5K OHM 1% 1/4W 1206	4.0 EA	R001 R002 R003 R004
843 5466 531	SCH, FEED FORWARD REF AMP	0.0 EA	
843 5466 533	PWB, FEED FORWARD REF AMP	1.0 EA	

Table 7-27. KIT, BOOST AMP - 992 9830 019

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (a)*
556 0051 000	PAD, FXD 50 OHM 10DB	1.0 EA	
620 3038 000	SPLITTER/COMBINER, 3-WAY	1.0 EA	
917 2506 088	CABLES, COAX PKG BOOST AMP	1.0 EA	
952 9215 191	PLATE, LINEARITY BOOST	1.0 EA	
992 9800 001	PWA, FEED FORWARD REF AMP	1.0 EA	

Table 7-28. ASSY, FOCUS POWER SUPPLY - 992 9883 014

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (g)*
296 0258 000	TUBING TEFLON 19AWG	0.1250 FT	
354 0003 000	LUG #10 RING RED 22-18AWG	7.0 EA	
356 0087 000	CABLE TIE TY RAP	9.0 EA	
358 0002 000	BRACKET RESISTOR MTG	2.0 EA	R006
358 2635 000	CABLE TIE, PUSH MOUNT SNAP IN	4.0 EA	
384 0761 000	BRIDGE, FW 100A 200V ESD	1.0 EA	V001
404 0847 000	HEAT SINK, ALUMINUM	1.0 EA	V001
472 1715 000	XFMR, PWR, 817-2336-013	1.0 EA	T001
524 0352 000	CAP 37000UF 75WVDC	3.0 EA	C001 C002 C003
540 0593 000	* RES 180 OHM 2W 5%	3.0 EA	R001 R002 R003
542 1560 000	* RES 0.05 OHM 110W	1.0 EA	R006
548 2400 193	RES 90.9 OHM 1/2W 1%	1.0 EA	R005
638 0021 000	SH, 30A 100MV	1.0 EA	
646 0665 000	INSPECTION LABEL	1.0 EA	
917 2506 062	CABLE, FOCUS POWER SUPPLY	1.0 EA	
922 1206 020	STRAP CONNECTION CAP	2.0 EA	
922 1297 054	RAIL, 4"	1.0 EA	
952 9202 175	SHELF, FOCUS SUPPLY	1.0 EA	
952 9202 176	CLAMP, FOCUS SUPPLY	1.0 EA	
952 9202 177	COVER, SAFETY, FOCUS SUPPLY	1.0 EA	
952 9202 232	COVER, SAFETY, FOCUS XFMR	1.0 EA	TRANSFORMER COVER
992 8800 001	FOCUS CURRENT OVLD ASSY	1.0 EA	A001
992 9883 021	ASSY, TERM BLK, FOCUS	1.0 EA	
999 2906 001	HARDWARE LIST,FOCUS PWR SUPPLY	1.0 EA	

Table 7-29. FOCUS CURRENT OVLD ASSY - 992 8800 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (g)*
254 0002 000	WIRE, BUS CU 20AWG	0.50 FT	
304 0075 000	NUT, HEX THIN 3/8-32	2.0 EA	
328 0033 000	WASHER FLAT STEEL	2.0 EA	
354 0309 000	TERM SOLDER	12.0 EA	E001 E002 E003 E004 E005 E012 E013 E014 E015 E016 E017 E018
382 0452 000	IC, LM311/CA311 ESD	2.0 EA	A001 A002
384 0205 000	DIODE SILICON 1N914/4148 ESD	2.0 EA	V006 V007
386 0082 000	ZENER, 1N4744A 15V 1W 5% ESD	1.0 EA	V001
386 0135 000	ZENER, 1N4733A 5.1V ESD	2.0 EA	V002 V003
386 0181 000	ZENER, 1N4739A 9.1V ESD	2.0 EA	V004 V005
404 0673 000	SOCKET 8 PIN DIP (DL)	2.0 EA	XA001 XA002
516 0375 000	CAP .01UF 50V -20/+80% Z5U	6.0 EA	C001 C002 C003 C004 C005 C006
522 0578 000	CAP 1.0UF 50V 20%	2.0 EA	C007 C008
540 0356 000	* RES 10K OHM 1W 5%	2.0 EA	R004 R005
548 2400 166	RES 47.5 OHM 1/2W 1%	1.0 EA	R006
548 2400 281	RES 681 OHM 1/2W 1%	2.0 EA	R003 R007
548 2400 569	RES 511K OHM 1/2W 1%	2.0 EA	R008 R009
550 0067 000	POT 10K OHM 2W 10%	2.0 EA	R001 R002
578 0021 000	RELAY DPDT 12V	2.0 EA	K001 K002
839 8121 028	SCHEM, FOCUS CURRENT OVLD	0.0 EA	
839 8121 029	PWB, FOCUS CURRENT OVLD	1.0 EA	

WARNING: Disconnect primary power prior to servicing.

Table 7-30. ASSY, IPA POWER SUPPLY - 992 9883 015

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (j)*
296 0372 000	SLEEVE, HEATSHRINK BOOT	2.0 EA	
307 0001 080	NUT, STD HEX M8, DIN 934	4.0 EA	SOCKET ASSY
384 0966 000	DIODE, SCHOTTKY 40V 100A ESD	1.0 EA	
736 0310 001	PWR SUPPLY, SW, 32V 2700W	2.0 EA	PS001, PS002
917 2413 503	RAIL, CARRIER, 5.6"	1.0 EA	
917 2506 069	CABLE, IPA POWER SUPPLY	1.0 EA	
917 2506 073	SOCKET, MODIFIED	2.0 EA	
922 1297 055	STANDOFF, IPA P/S, SIGMA+	2.0 EA	
939 8205 060	HOUSING, IPA CONNECTIONS	1.0 EA	
952 9215 144	DECK, IPA P/S, SIGMA+	1.0 EA	
952 9215 145	PLATE, IPA P/S, SIGMA+	2.0 EA	
952 9215 146	CLAMP, IPA P/S, SIGMA+	1.0 EA	
952 9215 147	HEATSINK, IPA P/S, SIGMA+	1.0 EA	
952 9215 182	COVER, IPA P/S DECK	1.0 EA	PS003
952 9215 200	COVER, SAFETY, IPA PS	2.0 EA	PS001 PS002
992 9502 017	*ASSY,MOV 380/415V(CONTACTOR)	1.0 EA	
992 9502 056	*PWA, FUSE PROTECTION, 15 AMP	1.0 EA	OBTAIN B/M FROM CAMBRIDGE
992 9883 020	ASSY, TERM BLK, IPA	1.0 EA	

Table 7-31. ASSY, TERM BLK, IPA - 992 9883 020

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (c)*
358 3000 000	PLATE, END STOP, DIN RAIL MT	2.0 EA	
358 3668 000	PLATE, END COVER (280, 4-COND)	1.0 EA	
358 3669 000	PLATE, SEPARATOR (281, 4-COND)	1.0 EA	
614 0795 000	JUMPER, HORIZONTAL 281	2.0 EA	
614 0925 000	BLOCK, TERM, FOUR POSITION	6.0 EA	
614 0926 000	BLOCK, FOUR TERM GROUND	2.0 EA	
614 0927 000	BLOCK, TERM, FOUR POSITION	5.0 EA	
822 1297 059	ASSY INSTR, TERM BLK IPA	0.0 EA	

Table 7-32. CONTACTOR/CIRCUIT BREAKER DOOR - 992 9883 016

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (r)*
358 3000 000	PLATE, END STOP, DIN RAIL MT	2.0 EA	TB021
358 3448 000	CLIP, RELAY RETAINING	2.0 EA	
358 3466 000	END PLATE W/FIXING FLANGE	1.0 EA	
358 3613 000	PLATE, END COVER (282, 2-COND)	1.0 EA	TB021
384 0702 000	RECT FW BRIDGE 600V 35A ESD	1.0 EA	V004
404 0866 000	SKT RELAY 14P PYF14A-E	1.0 EA	#K004
472 1784 000	XFMR CONTACTOR PANEL	1.0 EA	T001
542 0054 000	RES 10 OHM 5% 12W	1.0 EA	R002
570 0353 000	CNTOR 25A 600V 7.5HP 3PH	5.0 EA	K001 K002 K003 K005 K006
574 0503 000	RELAY 110VAC COIL 5A 4PDT	1.0 EA	K004
582 0064 000	RELAY, OVERLOAD 2.5-4 AMP	1.0 EA	K001
584 0319 000	CONTACT AUXILIARY	1.0 EA	K005
584 0331 000	CONTACT BLOCK, AUXILIARY	1.0 EA	K002
584 0335 000	CONTACT, AUX DPST (NC/NO)	1.0 EA	K002
606 0876 000	CONTACT AUXILIARY	11.0 EA	#Q001 #Q002 #Q003 #Q004 #Q005 #Q006 #Q007 #Q008 #Q009 #Q010 #Q011
606 0877 000	CKT BREAKER 3A 240VAC	6.0 EA	Q003 Q004 Q005 Q006 Q010 Q011

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606 0879 000	CKT BREAKER 6A 240VAC	1.0 EA	Q001
606 0900 000	CKT BREAKER 4A 415VAC	1.0 EA	Q002
606 0957 000	CKT BREAKER 0.25 AMP 1 POLE	1.0 EA	Q019
606 0959 000	CKT BREAKER 5 AMP 1 POLE	2.0 EA	Q017 Q018
606 0962 000	CIRCUIT BREAKER 1P 20AMP	3.0 EA	Q007 Q008 Q009
614 0883 000	MODULAR TERMINAL BLOCK	1.0 EA	
614 0884 000	MODULAR TERMINAL BLOCK 2C	5.0 EA	
614 0886 000	MODULAR TERMINAL BLOCK 4C	4.0 EA	
614 0915 000	TERM BLK, 2C MODULAR 282	7.0 EA	TB021
614 0923 000	TERM BLK, 2C MODULAR 282	1.0 EA	TB021
813 5012 053	STDOFF 10-32X2-3/4 RD	2.0 EA	
917 2506 059	CABLE PACKAGE, CENTER DOOR	1.0 EA	
922 1297 003	PATCH CB	1.0 EA	
922 1297 029	RAIL CB, FRONT PANEL	2.0 EA	
952 9215 149	DOOR, C.B.	1.0 EA	
992 9363 002	*CONTACTOR DRIVER	1.0 EA	
992 9737 043	*PWA, LED DISPLAY	1.0 EA	OBTAIN B/M FROM CAMBRIDGE
999 2914 001	HARDWARE LIST, CNTOR/CIRCUIT	1.0 EA	

Table 7-33. ASSY, SW METER/LINEARIZER - 992 9883 017

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (h)*
007 4050 021	BRZ, FINGERS TWIST 97-555	4.020 FT	
358 1214 000	SCREWLOCK, FEMALE	1.0 EA	
358 3427 000	CAP, KNOB BLACK 15MM DIA	1.0 EA	
3913-070-51860	*METER TO SPEC	1.0 EA	
556 0051 000	PAD, FXD 50 OHM 10DB	1.0 EA	AT2 @ KX5
636 0044 000	METER, ELAPSED TIME	1.0 EA	
650 0305 000	KNOB, ROUND PLAIN BLACK	1.0 EA	
917 2506 075	CABLE, SWITCH METER PANEL	1.0 EA	
952 9202 181	COVER, RF CORRECTOR SIGMA PLUS	1.0 EA	
952 9215 151	PANEL	1.0 EA	
952 9215 152	BOX	1.0 EA	
992 9502 048	*PWA, SWITCHED METER	1.0 EA	OBTAIN B/M FROM CAMBRIDGE
992 9881 001	*PWA, AGC & UHF LINEARIZER,	1.0 EA	
999 2921 001	HARDWARE LIST, SW METER/	0.0 EA	

Table 7-34. *PWA, AGC & UHF LINEARIZER, - 992 9881 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (j)*
055 0100 005	*THERMAL COMPOUND, 8OZ JAR	0.0 EA	U019 U020
300 1485 000	SCR, 4-40 X 5/16	2.0 EA	
304 0089 000	NUT, HEX 6-32	6.0 EA	
308 0005 000	NO 6 FLAT WASHER BRS	6.0 EA	
312 0045 000	WASHER, SPLIT-LOCK 4	2.0 EA	
312 0047 000	WASHER, SPLIT-LOCK 6	6.0 EA	
382 0184 000	IC, 340T-5/7805 +5V REG ESD	1.0 EA	U020
382 0605 000	IC 7905C ESD	1.0 EA	U019
404 0513 000	HEAT SINK PA1-1CB	2.0 EA	XU019 XU020
408 0332 000	SHIELD, RF	1.0 EA	
492 0839 000	IND 330 UH 10% 500MA	2.0 EA	L029 L030
522 0588 000	CAP 100UF 25V 20% NP	1.0 EA	C122
522 0591 000	CAP 47UF 25V 20%	4.0 EA	C130 C132 C133 C134
550 0622 000	POT 1K OHM .5W 10%	4.0 EA	R001 R003 R005 R007

550 0626 000	POT, 10K OHM .5W 10%	4.0 EA	R002 R004 R006 R008
550 0760 000	POT 20K OHM .5W 10%	3.0 EA	R009 R010 R011
550 0881 000	POT 100K OHM .5W 10%	1.0 EA	R012
604 1192 000	SWITCH TGL SPDT	1.0 EA	S001
610 0900 000	HEADER 3 CKT STRAIGHT	3.0 EA	JP001 JP002 JP003
610 0933 000	JUMPER, PWB TEST POINT	10.0 EA	TP001 TP002 TP003 TP004 TP005 TP006 TP007 TP008 TP009 TP010
610 1197 000	HEADER, STRAIGHT 6C	1.0 EA	J001
610 1198 000	HEADER, STRAIGHT 10C	1.0 EA	J002
612 1184 000	SHUNT JUMPER 0.1" CENTERS	3.0 EA	JP001 JP002 JP003
620 0515 000	RECP, SCREW ON SMC	4.0 EA	J003 J004 J005 J006
646 0665 000	INSPECTION LABEL	1.0 EA	
843 5502 001	SCH, AGC & UHF LINEARIZER	0.0 EA	
952 9202 172	BOARD, BACKER	1.0 EA	
992 9881 002	*PWA, AGC & UHF LINEARIZER,SMT	1.0 EA	

Table 7-35. *PWA, AGC & UHF LINEARIZER,SMT - 992 9881 002

Harris PN	*Description*	*QTY UM*	*Reference Designators (S)*
000 0000 010	B/M NOTE:	0.0 EA	THESE PARTS NOT USED AT THIS LEVEL C094
381 0003 001	XSTR, NPN, 3904 (SMT) ESD	2.0 EA	Q001 Q004
381 0023 000	FET SST215 SMT ESD	4.0 EA	Q002 Q003 Q005 Q006
382 1608 000	IC, ERA-5SM ESD	3.0 EA	U009 U015 U016
383 0183 000	IC, MC14538 ESD	1.0 EA	U006
383 0253 000	IC, LM358 ESD	2.0 EA	U001 U017
383 0283 000	IC, TL074 SMT ESD	3.0 EA	U007 U008 U018
383 0315 000	IC OP413 ESD	4.0 EA	U002 U003 U004 U005
383 0316 000	IC ERA-6SM SMT ESD	5.0 EA	U010 U011 U012 U013 U014
385 0001 000	DIODE, RECT 4148 / 914 ESD	3.0 EA	CR012 CR037 CR038
385 0013 000	DIODE, PIN ESD	16.0 EA	CR002 CR004 CR006 CR008 CR015 CR019 CR021 CR022 CR023 CR024 CR025 CR026 CR027 CR028 CR029 CR030
385 0018 000	DIODE, SCHOTTKY ESD	4.0 EA	CR001 CR003 CR005 CR007
385 0020 000	DIODE, HSMS2862 ESD	4.0 EA	CR014 CR016 CR017 CR020
385 0027 000	DIODE, 2800 SCHOTTKY SMT ESD	5.0 EA	CR009 CR011 CR013 CR018 CR036
387 0002 017	DIODE, TVS 15V 1500W ESD	6.0 EA	CR010 CR031 CR032 CR033 CR034 CR035
496 0015 000	IND, CHIP 0.150 UH 10%	23.0 EA	L001 L002 L003 L004 L005 L006 L007 L008 L009 L012 L013 L014 L015 L016 L017 L019 L020 L021 L022 L023 L024 L025 L028
496 0019 000	IND, CHIP 0.330 UH 10%	4.0 EA	L010 L018 L026 L027
496 0047 000	IND CHIP .1UH 10%	1.0 EA	L011
515 0038 000	*CAP 22PF 50V 5% 1206 COG	4.0 EA	C012 C013 C014 C017
515 0052 000	*CAP 330PF 50V 5% 1206 COG	39.0 EA	C032 C037 C038 C040 C043 C044 C048 C052 C055 C057 C062 C063 C066 C067 C077 C078 C083 C092 C096 C097 C098 C099 C101 C102 C103 C104 C105 C106 C107 C108 C109 C110 C111 C112 C113 C114 C115 C118 C119
515 0084 000	*CAP .01UF 50V 10% 1206 X7R	4.0 EA	C030 C124 C125 C135
515 0134 011	CAP 2.7PF 100V +/-.25 0805 C0G	2.0 EA	C136 C137
515 0134 017	CAP 4.7PF 100V +/-.25 0805 C0G	1.0 EA	C026
515 0134 117	CAP 47PF 100V 5% 0805 C0G	1.0 EA	C061
515 0134 201	CAP 100PF 100V 5% 0805 C0G	26.0 EA	

WARNING: Disconnect primary power prior to servicing.

			C015 C021 C036 C041 C049 C050 C053 C054 C056 C058 C059 C064 C065 C069 C070 C071 C072 C073 C074 C075 C076 C079 C089 C090 C093 C120
515 0134 211	CAP 270PF 100V 5% 0805 C0G	2.0 EA	C018 C020
515 0135 301	CAP 1000PF 100V 5% 1206 C0G	13.0 EA	C001 C022 C033 C068 C080 C081 C082 C084 C085 C086 C087 C095 C100
515 0137 501	CAP 0.1UF 50V 10% 1206 X7R	21.0 EA	C002 C003 C004 C005 C006 C007 C008 C009 C010 C011 C016 C019 C023 C024 C025 C027 C029 C123 C126 C127 C128
515 0138 501	CAP 0.1UF 100V 10% 1812 X7R	3.0 EA	C121 C129 C131
515 0138 601	CAP 1UF 50V 20% 1812 X7R	9.0 EA	C028 C034 C035 C042 C045 C046 C047 C051 C060
515 0181 000	CAP 4.7UF 16V Y5V 1206	2.0 EA	C31 C39
518 0112 000	CAP, TRIM 2-10PF 50V	4.0 EA	C088 C091 C116 C117
545 0121 000	RES 1M OHM 1/4W 5% 1206	3.0 EA	R057 R063 R072
545 0295 000	RES 10M OHM 1/4W 5% 1206	2.0 EA	R079 R082
545 0309 015	RES 3.92 OHM 1% 1/4W 1206	3.0 EA	R162 R163 R193
545 0309 019	RES 5.62 OHM 1% 1/4W 1206	2.0 EA	R152 R153
545 0309 023	RES 8.25 OHM 1% 1/4W 1206	2.0 EA	R085 R095
545 0309 101	RES 10 OHM 1% 1/4W 1206	9.0 EA	R032 R086 R087 R114 R115 R124 R125 R157 R158
545 0309 104	RES 13 OHM 1% 1/4W 1206	4.0 EA	R148 R149 R150 R151
545 0309 106	RES 16.2 OHM 1% 1/4W 1206	8.0 EA	R107 R116 R131 R133 R154 R156 R208 R209
545 0309 107	RES 18.2 OHM 1% 1/4W 1206	2.0 EA	R134 R135
545 0309 111	RES 26.7 OHM 1% 1/4W 1206	3.0 EA	R159 R160 R161
545 0309 116	RES 43.2 OHM 1% 1/4W 1206	3.0 EA	R155 R164 R166
545 0309 118	RES 51.1 OHM 1% 1/4W 1206	5.0 EA	R080 R089 R093 R094 R097
545 0309 119	RES 56.2 OHM 1% 1/4W 1206	1.0 EA	R121
545 0309 121	RES 68.1 OHM 1% 1/4W 1206	1.0 EA	R103
545 0309 122	RES 75 OHM 1% 1/4W 1206	1.0 EA	R024
545 0309 123	RES 82.5 OHM 1% 1/4W 1206	2.0 EA	R167 R168
545 0309 201	RES 100 OHM 1% 1/4W 1206	16.0 EA	R025 R028 R029 R030 R033 R043 R047 R048 R049 R050 R106 R145 R172 R176 R197 R205
545 0309 203	RES 121 OHM 1% 1/4W 1206	2.0 EA	R090 R091
545 0309 204	RES 130 OHM 1% 1/4W 1206	2.0 EA	R170 R171
545 0309 205	RES 150 OHM 1% 1/4W 1206	10.0 EA	R013 R015 R017 R019 R088 R098 R128 R138 R142 R173
545 0309 209	RES 221 OHM 1% 1/4W 1206	1.0 EA	R169
545 0309 210	RES 237 OHM 1% 1/4W 1206	5.0 EA	R031 R035 R036 R037 R144
545 0309 211	RES 267 OHM 1% 1/4W 1206	9.0 EA	R014 R016 R018 R020 R023 R060 R084 R111 R140
545 0309 214	RES 357 OHM 1% 1/4W 1206	32.0 EA	R076 R078 R081 R083 R092 R096 R099 R100 R101 R102 R104 R105 R108 R109 R110 R112 R113 R117 R118 R119 R120 R122 R123 R126 R127 R129 R130 R132 R136 R137 R139 R141
545 0309 216	RES 432 OHM 1% 1/4W 1206	1.0 EA	R143
545 0309 218	RES 511 OHM 1% 1/4W 1206	1.0 EA	R038
545 0309 224	RES 909 OHM 1% 1/4W 1206	1.0 EA	R201
545 0309 301	RES 1K OHM 1% 1/4W 1206	16.0 EA	R021 R022 R045 R055 R061 R066 R073 R074 R075 R077 R185 R188 R191 R195 R202 R204
545 0309 303	RES 1.21K OHM 1% 1/4W 1206	1.0 EA	R179
545 0309 308	RES 2K OHM 1% 1/4W 1206	2.0 EA	R200 R207
545 0309 310	RES 2.37K OHM 1% 1/4W 1206	2.0 EA	R146 R147
545 0309 314	RES 3.57K OHM 1% 1/4W 1206	1.0 EA	R206

545 0309 317	RES 4.75K OHM 1% 1/4W 1206	2.0 EA	R068 R180
545 0309 401	RES 10K OHM 1% 1/4W 1206	11.0 EA	R046 R054 R058 R064 R070 R071 R165 R175 R184 R190 R199
545 0309 409	RES 22.1K OHM 1% 1/4W 1206	2.0 EA	R059 R065
545 0309 412	RES 30.1K OHM 1% 1/4W 1206	1.0 EA	R198
545 0309 418	RES 51.1K OHM 1% 1/4W 1206	10.0 EA	R026 R027 R034 R040 R041 R042 R051 R052 R053 R069
545 0309 501	RES 100K OHM 1% 1/4W 1206	11.0 EA	R039 R044 R056 R062 R067 R181 R183 R186 R187 R194 R196
545 0309 508	RES 200K OHM 1% 1/4W 1206	7.0 EA	R174 R177 R178 R182 R189 R192 R203
620 2972 000	COUPLER, 3DB HYBRID SMT	4.0 EA	HY001 HY002 HY003 HY004
843 5502 001	SCH, AGC & UHF LINEARIZER	0.0 EA	
843 5502 003	PWB, AGC & UHF LINEARIZER	1.0 EA	

Table 7-36. CONTROL & MONITORING(SIGMA CD) - 992 9883 018

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (l)*
041 1310 030	GASKET, RUBBER	6.40 FT	
043 8030 010	PLASTIC CHAN NO 190	1.210 FT	
335 0267 000	WASHER SHOULDER .266 ID	1.0 EA	
356 0239 000	CLAMP, FLAT CABLE 3"	6.0 EA	
358 0420 000	SPACER, ROLLED 1/4 L	10.0 EA	
358 3386 000	SCREW, SHOULDER 10-32	1.0 EA	
358 3490 000	END STOP, 264 TERM BLOCK	2.0 EA	#TB011
358 3491 000	END PLATE, 264 TERM BLOCK	1.0 EA	#TB011
424 0033 000	GROMMET 1-1/16 MTG D	1.0 EA	
424 0360 000	GROMMET 1-3/4 MTG DIA	1.0 EA	
448 1125 000	LATCH, RAISED, ADJ LEVER	1.0 EA	
614 0892 000	TERM BLOCK, 4C RAIL MNT	5.0 EA	#TB011
632 1179 000	MTR, % POWER, 90MM W	2.0 EA	
632 1180 000	MTR, % POWER/VSWR 90MM W	1.0 EA	
917 2413 500	RAIL, CARRIER, 3.0"	1.0 EA	#TB011
917 2506 074	CABLE, CTLR & MONITOR DOOR	1.0 EA	
939 8205 059	HINGE CONTROL & MONITORING	1.0 EA	
943 5496 065	RIBBON CABLE, FRT CAB, DIGITAL	1.0 EA	
952 9190 214	*OVERLAY SIGMA + CD	1.0 EA	
952 9215 160	BOX CONTROL MONITORING	1.0 EA	
952 9215 163	ASSY, FRAME CONTROL & MONITOR	1.0 EA	
952 9215 180	LID CONTROL & MONITORING	1.0 EA	
992 8737 003	*PWA, P/S UNIT DISTRIBUTION	1.0 EA	
992 8739 001	*PWA, ANALOG/DIGITAL INTERFACE	1.0 EA	
992 9371 002	*PWA, LOGIC & CONTROL	1.0 EA	

Table 7-37. ASSY, TERM BLK CUSTOMER INTFC - 992 9883 019

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (f)*
358 3000 000	PLATE, END STOP, DIN RAIL MT	2.0 EA	
358 3611 000	PLATE, END COVER (280, 3-COND)	1.0 EA	
358 3612 000	PLATE, BARRIER (282, 2-COND)	1.0 EA	
358 3669 000	PLATE, SEPARATOR (281, 4-COND)	1.0 EA	
358 3703 000	PLATE, STEP-DOWN (282, 2-COND)	1.0 EA	
614 0795 000	JUMPER, HORIZONTAL 281	1.0 EA	
614 0915 000	TERM BLK, 2C MODULAR 282	8.0 EA	
614 0917 000	TERM BLK, 3C MODULAR 280	19.0 EA	
614 0920 000	JUMPER, 2-POLE ADJACENT 282	1.0 EA	

614 0923 000	TERM BLK, 2C MODULAR 282	2.0 EA
614 0927 000	BLOCK, TERM, FOUR POSITION	2.0 EA
614 0932 000	JUMPER, 2P ADJACENT STEP-DOWN	1.0 EA
614 0935 000	TERM BLK, 2C MODULAR 280	2.0 EA
822 1297 058	ASSY INSTR, TERM BLK	0.0 EA
922 1297 061	RAIL, DIN 11.2	1.0 EA

Table 7-38. CABINET, CONTROL (CD1A) - 992 9824 002

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (s)*
041 1310 030	GASKET, RUBBER	13.750 FT	
358 0420 000	SPACER, ROLLED 1/4 L	10.0 EA	
358 2995 000	END PLATE, 261 TERM BD	1.0 EA	TB-5
358 3224 000	BUSHING, NYLON 17/64 ID	1.0 EA	
358 3385 000	PIN QUICK RELEASE 1/4X4.0	1.0 EA	
358 3490 000	END STOP, 264 TERM BLOCK	4.0 EA	TB002 TB004
358 3491 000	END PLATE, 264 TERM BLOCK	3.0 EA	(1) TB002, (2) TB004
398 0544 000	FUSE 5X20 1.6A TIME DELAY	1.0 EA	
402 0113 000	CLIP, FUSE 13/32 DIA	8.0 EA	STRETCHER MTG
402 0217 000	FUSEHOLDER 5X20MM QC TERM	1.0 EA	
448 0319 000	CATCH MAGNETIC	1.0 EA	
448 0923 000	LATCH, WINGHANDLE W/NUT	1.0 EA	
448 0999 000	HINGE DOOR POSITIONING	2.0 EA	
614 0786 000	TERM BD, 2C MODULAR 261	2.0 EA	(2) TB-5
614 0892 000	TERM BLOCK, 4C RAIL MNT	13.0 EA	(6) TB002 (7) TB004
614 0896 000	TERM BLOCK, 4C GND	3.0 EA	(2) TB002 (1) TB004
620 2109 000	JACK, BNC 75 OHM BULKHEAD	2.0 EA	SEMPTE 310M
620 3042 000	ADAPTER,SMA F/M TO N F/M BLKHD	1.0 EA	RF SAMPLE
646 1483 000	HARRIS NAMEPLATE	1.0 EA	
736 0301 000	PWR SUPPLY, LINEAR 12V 3.4AMP	1.0 EA	MODE CONTROL
827 6893 001	PLATE	2.0 EA	
843 5496 049	WIRING DIAG, CTLR/CD-1A EXC	0.0 EA	
917 2413 350	CARRIER RAIL, 4.6"	2.0 EA	TB002 TB004
917 2506 070	CABLE PKG, CTLR CAB, LIN/DGTL	1.0 EA	
922 1297 009	BLOCK, DOOR PIVOT	1.0 EA	
922 1297 013	RAIL, CABLE SUPPORT	3.0 EA	EXC/SW, EXC A, EXC B
922 1297 014	BRACKET, CABLE SUPPORT	3.0 EA	EXC/SW, EXC A, EXC B
922 1297 047	BRACKET, LATCH MTG	1.0 EA	
939 8205 052	ANGLE, I/O & PCB MTG	1.0 EA	
939 8210 045	COVER, MOV BOARD	1.0 EA	
943 5496 009	PANEL, BLANK FILLER	1.0 EA	
943 5496 013	SEAL, GASKET	2.0 EA	
952 9202 156	SUPPORT, EXC, SIGMA + CTLR CAB	4.0 EA	
952 9202 157	SUPPORT, EXC/SW, CTLR CABINET	2.0 EA	
952 9215 016	ASSY, WELDMENT, CONTROL CAB	1.0 EA	
952 9215 018	PANEL, LEFT INNER	1.0 EA	
952 9215 019	PANEL, RIGHT INNER	1.0 EA	
952 9215 126	BLANK PNL, 8U, W/TOP FLANGE	1.0 EA	
952 9215 131	BLANK PANEL, 1 RACK UNIT	2.0 EA	
952 9215 148	CVR,SAFETY,MODE CTLR P/S UNIT	1.0 EA	
952 9215 202	STRAP, GROUND	1.0 EA	
952 9215 203	STRAP, GROUND	1.0 EA	
952 9215 204	BRACKET, LINE STRETCHER MTG	2.0 EA	
952 9215 205	INSULATOR, MOV	1.0 EA	
992 8553 001	PWA, MOV-AC 198-250 VAC	2.0 EA	

992 8810 001	*ASSY, HANDHELD DIAGNOSTICS	1.0 EA
992 9367 001	*PWA, MARSHALLING	1.0 EA
992 9502 067	*SYS INTERFACE PCB ASSY (CD)	1.0 EA
992 9830 006	PANEL, SYSTEM CONTROL (CD)	1.0 EA
992 9834 001	*PWA, EXCITER P/S DISTRIBUTION	1.0 EA
992 9848 001	ASSY, POWER SUPPLY DECK,	1.0 EA
992 9883 003	ASSY, REAR DOOR, CONTROL CAB	1.0 EA

Table 7-39. PWA, MOV-AC 198-250 VAC - 992 8553 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (e)*
296 0345 000	TUBING, SHRINKABLE 3/4	1.0 FT	CUT 12 PIECES 1.0" EACH
560 0111 000	VARISTOR 275VAC 140J 275VRMS	12.0 EA	CR001 CR002 CR003 CR004 CR005 CR006 CR007 CR008 CR009 CR010 CR011 CR012
610 1066 000	CONN, .25 FASTON PC MOUNT	3.0 EA	A B C
839 7900 606	PWB, MOV-AC PROTECTOR	1.0 EA	
839 7900 614	SCHEM, MOV-AC PROTECTOR	0.0 EA	
999 2710 001	WIRE/TUBING LIST	0.0 EA	QTY 1 NEEDED FOR SERVICEREPLACE-MENT.

Table 7-40. PANEL, SYSTEM CONTROL (CD) - 992 9830 006

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (c)*
335 0267 000	WASHER SHOULDER .266 ID	1.0 EA	
358 0420 000	SPACER, ROLLED 1/4 L	12.0 EA	
358 3386 000	SCREW, SHOULDER 10-32	1.0 EA	
448 0729 000	STRIKE MAGNETIC CATCH	1.0 EA	
632 1180 000	MTR, % POWER/VSWR 90MM W	1.0 EA	
632 1181 000	MTR, 0-50 SCL 120MM W	2.0 EA	
952 9190 673	*SYS OVERLAY PNL SIGMA (CD)	1.0 EA	
952 9215 025	FRAME, DOOR FRT, CTLR/MONITOR	1.0 EA	
952 9215 026	DOOR, FRONT ASSY, CONTROL CAB	1.0 EA	
992 9502 023	*SYS DISPLAY PCB ASSY (CD)	1.0 EA	

Table 7-41. ASSY, POWER SUPPLY DECK, - 992 9848 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (e)*
254 0003 000	WIRE, BUS CU 18AWG	0.750 FT	
354 0003 000	LUG #10 RING RED 22-18AWG	4.0 EA	
358 3490 000	END STOP, 264 TERM BLOCK	2.0 EA	#TB001
358 3491 000	END PLATE, 264 TERM BLOCK	1.0 EA	#TB001
384 0860 000	LED GREEN CART 24V ESD	6.0 EA	DS001 DS002 DS003 DS004 DS005 DS006
560 0036 000	MOV 6500A 80J 150 VAC	2.0 EA	CB001 CB002
606 0866 000	BREAKER, CIRCUIT 10A	2.0 EA	CB001 CB002
614 0892 000	TERM BLOCK, 4C RAIL MNT	12.0 EA	#TB001
736 0305 000	POWER SUPPLY, 24V 3.6A	2.0 EA	PS002A PS002B
736 0306 000	POWER SUPPLY, 15V 9A	2.0 EA	PS001A PS001B
736 0307 000	POWER SUPPLY, 15V 3A	2.0 EA	PS003A PS003B
839 8203 022	WIRING DIAG, PWR SUPPLY DECK	0.0 EA	
917 2413 341	CARRIER RAIL - 6.3"	1.0 EA	#TB001
917 2462 121	BRACKET, MOUNTING	10.0 EA	
917 2506 065	CABLE, CTLR CABINET PWR SUPPLY	1.0 EA	
943 5285 156	BRACKET, C.B. DOUBLE	2.0 EA	
952 9202 148	BASE, POWER SUPPLY MOUNTING	1.0 EA	

WARNING: Disconnect primary power prior to servicing.

952 9202 149	COVER, SAFETY	1.0 EA	
952 9202 151	COVER, SAFETY, CB	1.0 EA	#CB001 #CB002

Table 7-42. KIT, EEV FITTINGS - 992 9830 002

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (f)*
252 0004 000	WIRE, STRD 18AWG WHT/YEL	1.0 FT	
296 0253 000	TUBING, SHRINK 3/16 WHITE	4.0 FT	
296 0265 000	TUBING, SHRINK 1/16 WHITE	0.50 FT	
302 0057 000	SCR, 4-40 X 5/8	2.0 EA	
303 4104 012	SCREW, MACH M4-0.7 X 12	1.0 EA	
303 4105 012	SCREW, MACH M5-0.8 X 12	2.0 EA	
306 0015 000	NUT, HEX KEP 4-40	2.0 EA	
306 0034 000	NUT, HEX 1/2-13	1.0 EA	
310 0026 000	WASHER, FLAT 1/2	1.0 EA	
314 0015 000	WASHER, SPLIT-LOCK 1/2	1.0 EA	
354 0004 000	LUG .25 RING RED 22-18AWG	2.0 EA	
356 0005 000	CABLE CLAMP 5/16 D	1.0 EA	
359 1203 000	COUPLING, FLEXIBLE, 2 X 1-1/2	1.0 EA	
506 0250 000	CAP 1.0UF 250V 5%	1.0 EA	
843 5496 001	INSTR, LOCATOR PIN & CONNECT	0.0 EA	
917 2506 018	LOCATOR PIN	1.0 EA	
917 2506 038	CABLE, TUBE EEV	1.0 EA	
922 1297 028	MOUNT CONNECTOR	1.0 EA	
922 1297 046	ASSY, INPUT/OUTPUT BODY	2.0 EA	
939 8121 251	*LABEL, KLYSTON INSTN/REML.	1.0 EA	
943 5496 037	ASSY, INPUT, COLLECTOR, EEV	1.0 EA	
943 5496 038	ASSY, OUTPUT COLLECTOR	1.0 EA	

Table 7-43. ASSY, INPUT, COLLECTOR, EEV - 943 5496 037

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (a)*
003 8020 030	CU, TBG .75 NOM DIA	0.180 FT	
358 0935 000	CLAMP, HOSE	4.0 EA	
358 2718 000	SOCKET, FEMALE 6-HK	1.0 EA	
358 3026 000	HOSE BARB 3/4 H X 3/4 MPT	2.0 EA	
359 0150 000	ADAPTER FTG 3/4-3/4	1.0 EA	
359 0321 000	PLUG PIPE 1/8 NPT	1.0 EA	
359 1071 000	TEE 3/4 X 1/8 X 3/4 CXFXC	1.0 EA	
359 1173 000	NUT, C-61 7/8"	1.0 EA	
359 1174 000	SLEEVE, C-60 7/8"	1.0 EA	
424 0663 000	HOSE 48 IN LG	1.0 EA	
843 5496 037	ASSY INSTR,INPUT,COLLECTOR,EEV	0.0 EA	

Table 7-44. ASSY, OUTPUT COLLECTOR - 943 5496 038

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (a)*
003 8020 030	CU, TBG .75 NOM DIA	0.180 FT	
358 0935 000	CLAMP, HOSE	4.0 EA	
358 2718 000	SOCKET, FEMALE 6-HK	1.0 EA	
358 3026 000	HOSE BARB 3/4 H X 3/4 MPT	2.0 EA	
359 0592 000	ELBOW 3/4 IN 90 DEG	1.0 EA	
359 1173 000	NUT, C-61 7/8"	1.0 EA	
359 1174 000	SLEEVE, C-60 7/8"	1.0 EA	

424 0663 000	HOSE 48 IN LG	1.0 EA	
442 0123 000	THERMOSTAT 155 DEG F N.C.	1.0 EA	
843 5496 038	ASSY INSTR, OUTPUT COLLECTOR	0.0 EA	
917 2506 041	PLATE, TEMP SENSOR MTG	1.0 EA	

Table 7-45. KIT, SINGLE IPA - 992 9830 016

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (h)*
358 3434 000	TY-RAP MTG BASE .316" TIE	2.0 EA	
358 3455 000	STANDOFFS, HEX, 3/8	2.0 EA	
700 1377 000	TERMINATION, 50 OHM BNC	1.0 EA	SP001
917 2506 086	CABLES, COAX PKG SINGLE IPA	1.0 EA	
952 9215 199	COVER, SAFETY, IPA CLOSEOUT	1.0 EA	L002, CLOSEOUT
992 8741 001	*COMBINER, IPA	1.0 EA	

Table 7-46. KIT, DUAL IPA - 992 9830 017

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (m)*
296 0344 000	TUBG, POLYETHYLENE 1/4 OD	1.50 FT	CUT 12" & 6"
357 0109 000	TEE, HOSE BARB STYLE	1.0 EA	IPA BLOWERS
917 2506 054	CONNECTOR, BACKPLANE	4.0 EA	
917 2506 084	STANDOFF, HEATSINK MTG	4.0 EA	
917 2506 085	CABLES, COAX PKG DUAL IPA	1.0 EA	
917 2506 104	BRACKET,BNC,CAVITY PWR MONITOR	1.0 EA	CAVITY PWR MON
917 2506 108	CABLE, COAX W26	1.0 EA	CAVITY PWR MON
939 8205 016	SUPPORT	1.0 EA	
992 8734 001	*MODULE, 1KW S.S. AMPLIFIER	1.0 EA	IPA 2
992 9737 097	*COMBINER, 8-WAY,	1.0 EA	
992 9737 098	*ASSY, LOAD, 3-WAY,	1.0 EA	
992 9830 014	KIT, 3RD POWER SUPPLY	1.0 EA	PSU 3
992 9830 022	COOLING, IPA, LEFT	1.0 EA	IPA 2 BLOWER

Table 7-47. KIT, 3RD POWER SUPPLY - 992 9830 014

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (b)*
296 0372 000	SLEEVE, HEATSHRINK BOOT	2.0 EA	
307 0001 080	NUT, STD HEX M8, DIN 934	4.0 EA	
384 0966 000	DIODE, SCHOTTKY 40V 100A ESD	1.0 EA	
736 0310 001	PWR SUPPLY, SW, 32V 2700W	1.0 EA	PS3
917 2506 073	SOCKET, MODIFIED	2.0 EA	
917 2506 090	CABLE PKG, 3RD POWER SUPPLY	1.0 EA	825, 826
939 8205 060	HOUSING, IPA CONNECTIONS	1.0 EA	
952 9215 145	PLATE, IPA P/S, SIGMA+	1.0 EA	
952 9215 200	COVER, SAFETY, IPA PS	1.0 EA	PSU3

Table 7-48. COOLING, IPA, LEFT - 992 9830 022

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (e)*
041 1310 030	GASKET, RUBBER	3.1670 FT	
296 0262 000	TUBING, SHRINK 1/4 WHITE	0.1670 FT	
358 3466 000	END PLATE W/FIXING FLANGE	1.0 EA	TB15A
426 0081 000	MOUNT, ANTI-VIBRATION (METRIC)	4.0 EA	
430 0241 000	FAN GUARD	1.0 EA	
430 0251 000	FAN CENTRIFUGAL	1.0 EA	

614 0885 000	MODULAR TERMINAL BLOCK	1.0 EA	TB15A
614 0886 000	MODULAR TERMINAL BLOCK 4C	3.0 EA	TB15A
646 0665 000	INSPECTION LABEL	1.0 EA	
939 8121 928	BRACKET, FAN MOUNTING	1.0 EA	
939 8205 062	SUPPORT, IPA COOLING	2.0 EA	
952 9215 177	BOX, IPA COOLING	1.0 EA	
952 9215 178	LID, IPA COOLING	1.0 EA	
999 2916 001	HARDWARE LIST, COOLING IPA	1.0 EA	

Table 7-49. KIT, DUAL EXCITER - 992 9830 020

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (c)*
620 2964 000	POWER SPLITTER, 2-WAY	1.0 EA	SPL-1, RF SAMPLE
917 2506 089	CABLES, COAX PKG DUAL EXCITER	1.0 EA	RF SAMPLE JUMPER I/O TO SPLITTER
992 9843 005	SWITCHER, EXCITER, SIGMA UHF	1.0 EA	

Table 7-50. SWITCHER, EXCITER, SIGMA UHF - 992 9843 005

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (j)*
296 0253 000	TUBING, SHRINK 3/16 WHITE	0.210 FT	K001
356 0208 000	CLAMP, FLAT CABLE 2"	1.0 EA	
358 2598 000	CABLE TIE MOUNT, 4-WAY	1.0 EA	
358 3223 000	FEMALE SCREWLOCK .56"4-40	6.0 EA	
358 3579 000	SLIDES, DRAWER	1.0 EA	
358 3625 000	SLIDES, DRAWER 1.38 X 14 LG	0.0 EA	OPTIONAL
448 1101 000	HANDLE, ALUMINUM	2.0 EA	
583 0152 000	RELAY, COAX TRANSFER	1.0 EA	K001
598 0470 000	FRAME, SNAP-IN, BLACK	3.0 EA	#S001 #S002 #S003
620 2965 000	POWER SPLITTER, 4-WAY	1.0 EA	SPL-1
646 0665 000	INSPECTION LABEL	1.0 EA	
700 1404 000	TERMINATION, 50 OHM 0.25W BNC	3.0 EA	R003 R004 R005
700 1405 000	TERMINATION, 50 OHMS 2W	1.0 EA	R001
839 8203 018	BLOCK DIAG,EXC SWITCHER SYSTEM	0.0 EA	
839 8203 019	WIRING DIAG, EXCITER SWITCHER	0.0 EA	
917 2510 016	CABLE PKG, EXCITER SWITCHER	1.0 EA	
939 8203 027	ANGLE, MINI CKT MTG.	1.0 EA	
939 8203 032	COVER, REAR, SYNC-LO-SOUND	1.0 EA	
939 8203 034	CHASSIS, EXC/SW, CA1/CD1 EXC	1.0 EA	
939 8203 035	COVER, EXC/SW, (CA1/CD1 EXC)	1.0 EA	
939 8203 036	PANEL, FRT, EXC/SW (CD1)	1.0 EA	
988 2426 001	DP, EXCITER SWITCHER CD	2.0 EA	
992 9843 006	PWA, EXCITER SWITCHER, DTV	1.0 EA	
999 2900 001	HARDWARE LIST,EXCITER SWITCHER	1.0 EA	

Table 7-51. PWA, EXCITER SWITCHER, DTV - 992 9843 006

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (h)*
296 0310 000	TUBING TEFLON 20 AWG	0.730 FT	
358 1928 000	JUMPER 1/4 LG 1/8H	4.0 EA	JP019 JP020 JP021 JP022
380 0773 000	XSTR FET BS170 N-CHL ESD	7.0 EA	Q001 Q002 Q003 Q004 Q005 Q006 Q007
382 0288 000	IC, 4011/14011 ESD	1.0 EA	U006
382 0302 000	IC, 4023/14023 ESD	2.0 EA	U002 U005
382 0367 000	IC, 4049/14049 ESD	1.0 EA	U009
382 0414 000	IC, CD4002/MC14002 ESD	2.0 EA	U013 U014

382 0594 000	IC TL074ACN ESD	1.0 EA	U011
382 0618 000	IC, 4081/14081 ESD	2.0 EA	U003 U010
382 0719 000	IC LM324AN ESD	1.0 EA	U020
382 1070 000	IC, ILQ-1 OPTO-ISOLATOR ESD	4.0 EA	U007 U022 U023 U024
382 1192 000	IC, MC14584BCP ESD	2.0 EA	U004 U018
382 1210 000	IC CD4538B ESD	1.0 EA	U012
382 1629 000	IC ULN2804 ESD	5.0 EA	U001 U008 U017 U019 U021
383 0302 000	IC, LT1206CR ESD	2.0 EA	U015 U016
384 0205 000	DIODE SILICON 1N914/4148 ESD	45.0 EA	CR001 CR002 CR003 CR004 CR005 CR010 CR011 CR012 CR013 CR014 CR015 CR016 CR017 CR018 CR019 CR020 CR021 CR022 CR023 CR024 CR025 CR026 CR027 CR028 CR029 CR030 CR031 CR032 CR033 CR034 CR035 CR036 CR051 CR052 CR053 CR054 CR055 CR056 CR057 CR059 CR060 CR061 CR062 CR063 CR064
384 0597 000	RECT 1N4002 ESD	18.0 EA	CR006 CR007 CR008 CR009 CR037 CR038 CR039 CR040 CR041 CR042 CR043 CR044 CR045 CR046 CR047 CR048 CR049 CR050
384 0660 000	DIODE, REFERENCE ESD	1.0 EA	CR058
384 0837 000	TRANSZORB 1N6376 12V 5W ESD	2.0 EA	CR065 CR066
384 0903 000	LED, RED, T-1 ESD	3.0 EA	DS010 DS016 DS027
384 0904 000	LED, GRN, T-1 ESD	7.0 EA	DS001 DS004 DS006 DS009 DS024 DS025 DS026
384 0961 000	LED, YELLOW ESD	7.0 EA	DS002 DS003 DS005 DS007 DS008 DS022 DS023
404 0507 000	SOCKET IC 18 PIN	5.0 EA	XU001 XU008 XU017 XU019 XU021
404 0674 000	SOCKET 14 PIN DIP (D-L)	11.0 EA	XU002 XU003 XU004 XU005 XU006 XU010 XU011 XU013 XU014 XU018 XU020
404 0675 000	SOCKET IC 16 CONT	6.0 EA	XU007 XU009 XU012 XU022 XU023 XU024
404 0824 000	SOCKET, DIP14, LO PROFILE	8.0 EA	XK007A XK007B XK008A XK008B XK009A XK009B XK010A XK010B
404 0825 000	SOCKET, DIP16, LO PROFILE	4.0 EA	XK003 XK004 XK005 XK006
516 0453 000	CAP .1UF 100V 20% X7R	13.0 EA	C006 C008 C009 C011 C012 C013 C014 C017 C018 C019 C020 C028 C032
516 0530 000	CAP .01UF 10% 100V X7R	16.0 EA	C001 C002 C003 C004 C016 C021 C023 C024 C025 C026 C027 C029 C030 C031 C033 C034
516 0736 000	CAP .001UF 10% 100V X7R	2.0 EA	C037 C038
522 0548 000	CAP 10UF 50V 20%	1.0 EA	C035
522 0550 000	CAP 100UF 25V 20%	5.0 EA	C005 C007 C010 C036 C039
522 0570 000	CAP 2.2UF 50V 20%	2.0 EA	C015 C022
540 1372 000	RES NETWORK 680 OHM 2%	3.0 EA	R047 R048 R049
540 1416 000	RES NETWORK 10K OHM 2%	6.0 EA	R021 R023 R064 R066 R068 R072
540 1430 000	RES NETWORK, 10K OHM 2%	3.0 EA	R012 R017 R092
540 1437 000	RES NETWORK 2000 OHM 2%	3.0 EA	R028 R065 R071
545 0309 118	RES 51.1 OHM 1% 1/4W 1206	2.0 EA	R001 R002
548 2051 000	RES ZERO OHM	2.0 EA	R039 R052
548 2400 156	RES 37.4 OHM 1/2W 1%	2.0 EA	R032 R033
548 2400 185	RES 75 OHM 1/2W 1%	6.0 EA	R029 R030 R031 R036 R046 R054
548 2400 269	RES 511 OHM 1/2W 1%	1.0 EA	R087
548 2400 285	RES 750 OHM 1/2W 1%	4.0 EA	R037 R038 R050 R051
548 2400 301	RES 1K OHM 1/2W 1%	15.0 EA	

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			R003 R004 R005 R006 R007 R008 R009 R011 R024 R041 R042 R053 R059 R075 R091
548 2400 330	RES 2K OHM 1/2W 1%	5.0 EA	R076 R077 R078 R079 R080
548 2400 342	RES 2.67K OHM 1/2W 1%	1.0 EA	R067
548 2400 368	RES 4.99K OHM 1/2W 1%	8.0 EA	R013 R014 R015 R016 R026 R027 R040 R043
548 2400 380	RES 6.65K OHM 1/2W 1%	2.0 EA	R018 R020
548 2400 401	RES 10K OHM 1/2W 1%	19.0 EA	R010 R025 R034 R035 R044 R045 R056 R057 R060 R062 R081 R082 R083 R084 R085 R086 R088 R089 R090
548 2400 701	RES 10MEG OHM 1/2W 1%	4.0 EA	R055 R058 R061 R063
550 0913 000	POT, 5K OHM	4.0 EA	R069 R070 R073 R074
574 0477 000	RELAY 4 PDT 12VDC 2 AMP	4.0 EA	K007 K008 K009 K010
574 0485 000	RELAY DPDT 12VDC 2 AMP	3.0 EA	K003 K004 K005
578 0026 000	RELAY DPDT 12VDC 2 AMP	1.0 EA	K006
578 0029 000	RELAY 12V SPCO RF SW PCB	2.0 EA	K001 K002
604 1147 000	SW PB SPST-N.O. MOM	1.0 EA	S004
604 1205 000	SW, SPDT MOMENTARY	3.0 EA	S001 S002 S003
610 0827 000	HEADER, 20 PIN PC RIBBON	1.0 EA	J004
610 0828 000	HEADER, 26 PIN PC RIBBON	4.0 EA	J001 J002 J003 J008
610 0830 000	HEADER, 10 PIN PC RIBBON	1.0 EA	J007
610 0855 000	HEADER 34 PIN PC RIBBON	2.0 EA	J010 J010A
610 0900 000	HEADER 3 CKT STRAIGHT	18.0 EA	JP001 JP002 JP003 JP004 JP005 JP006 JP007 JP008 JP009 JP010 JP011 JP012 JP013 JP014 JP015 JP016 JP017 JP018
610 0933 000	JUMPER, PWB TEST POINT	10.0 EA	TP001 TP002 TP003 TP004 TP005 TP006 TP007 TP008 TP009 TP010
610 0950 000	PIN HEADER 6 PIN	1.0 EA	J009
610 1304 000	HEADER, 16 PIN PC RIBBON	2.0 EA	J005 J006
612 1184 000	SHUNT JUMPER 0.1" CENTERS	18.0 EA	XJP001 XJP002 XJP003 XJP004 XJP005 XJP006 XJP007 XJP008 XJP009 XJP010 XJP011 XJP012 XJP013 XJP014 XJP015 XJP016 XJP017 XJP018
620 0700 000	*RECPT, MALE SMB,PC MOUNT	9.0 EA	J030 J031 J032 J033 J034 J035 J038 J039 J040
839 8203 001	SCH, EXCITER SWITCHER PWB	0.0 EA	
839 8203 002	LAYOUT, COMPONENT,	0.0 EA	
839 8203 003	PWB, EXCITER SWITCHER	1.0 EA	

Table 7-52. KIT, SINGLE EXCITER - 992 9830 021

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (c)*
620 2833 000	SPLITTER/COMBINER, 4-WAY	1.0 EA	SPL-2
700 1404 000	TERMINATION, 50 OHM 0.25W BNC	3.0 EA	USE AS REQUIRED
952 9215 132	BLANK PANEL, 2 RACK UNITS	1.0 EA	EX/SW CLOSEOUT
952 9215 134	BLANK PANEL, 4 RACK UNITS	1.0 EA	EXCITER B CLOSEOUT

Table 7-53. KIT, CPI ASSY - 992 9830 026

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (f)*
055 0120 538	CONDUIT FITTING 45 DEG ELBOW	1.0 EA	UMBILICAL
296 0394 026	TUBING, RF/EMI SHIELD 1.250 ID	0.750 FT	UMBILICAL

356 0253 000	CABLE CLAMP, SIZE 22 SHELL	1.0 EA	YX007
358 1315 000	CLAMP, ADJ, SIZE 16	1.0 EA	UMBILICAL
612 1562 000	PLUG, CIRCULAR, 4 PIN FEMALE	1.0 EA	YX007
839 8121 926	*SCH, ISO SUPPLIES 3 (EEV)	0.0 EA	
843 5496 075	SCH, FRT/REAR CAB (CPI)	0.0 EA	
917 2506 115	CABLE, BODY CURRENT	1.0 EA	
939 8121 251	*LABEL, KLYSTON INSTN/REML.	1.0 EA	
943 5479 016	CABLE, HV UMBILICAL EIMAC K2	1.0 EA	UMBILICAL
943 5496 072	ASSY,CPI PLUMBING W/FLOW METER	1.0 EA	
952 9215 208	CONDUIT, UMBILICAL, CPI	1.0 EA	
992 9737 105	*SUPPLIES, ISO, 3 (CPI)	1.0 EA	
992 9830 025	METERS, ISO, CPI	1.0 EA	

Table 7-54. ASSY,CPI PLUMBING W/FLOW METER - 943 5496 072

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (b)*
003 8020 040	CU, TBG 1.0 NOM DIA	3.10 FT	
358 3040 000	PLUG, FEMALE 6-HK	1.0 EA	
358 3459 000	PLUG, FEMALE 4-HK	1.0 EA	
359 0228 000	ELBOW 45 DEG, 1" CXC	1.0 EA	
359 0269 000	ADAPTER, MALE	1.0 EA	
359 0660 000	Y 45 DEG 1 IN.	1.0 EA	
359 0975 000	ADAPTER, MALE	1.0 EA	
604 1206 000	SWITCH, LIMIT	2.0 EA	
629 0085 000	FLOW METER, HEDLAND 620-604	1.0 EA	
629 0087 000	FLOW METER, HEDLAND 620-628	1.0 EA	
843 5496 072	ASSY INSTR,CPI PLUMBING W/FLOW	0.0 EA	

Table 7-55. METERS, ISO, CPI - 992 9830 025

Harris PN	*Description*	*QTY UM*	*Reference Designators (H)*
335 0012 000	WASHER NYLON .195 ID	4.0 EA	
354 0146 000	LUG SHAKE .176 MTG	13.0 EA	
354 0890 000	TERM, MALE 250 TAB, #6 HOLE	11.0 EA	
357 0071 000	SCREW 10-32 X 1/2	4.0 EA	
358 0960 000	CPLR, 1/4"X1/4" SHAFT	1.0 EA	
384 0888 000	RECT BYW96E 1000V 3A ESD	2.0 EA	
384 0968 000	DIODE, BAW62 ESD	2.0 EA	V001 V002
410 0022 000	INSULATOR ROUND NS5W0332	2.0 EA	
516 0968 000	CAP 4700PF 5% 100V C0G	5.0 EA	C001 C002 C003 C004 C005
540 1600 322	RES 7.5K OHM 3W 5%	1.0 EA	R002
552 0997 000	POT 1K OHM 2W 5% 10 TURN	1.0 EA	R001
560 0095 000	MOV, 130WVAC, 70J, 20MM DISC	1.0 EA	RV001
632 1175 000	MTR, 0-50UA, 90MM W	1.0 EA	ION PUMP P002
632 1176 000	MTR, 0-150V, 90MM W	1.0 EA	BIAS VOLTS P003
632 1193 000	MTR 0-12V HEATER V 90MM W	1.0 EA	HEATER VOLTS P001
632 1204 000	METER TO SPEC, 0-20A	1.0 EA	HEATER CURRENT P005
632 1205 000	METER, BIAS CURRENT	1.0 EA	BIAS CURRENT P004
917 2501 035	JUMPER PKG, METER, ISO	1.0 EA	
917 2506 016	SHAFT BIAS ADJUST	1.0 EA	
922 1297 048	BIAS, POT MTG BRKT	1.0 EA	
922 1297 049	ELECTROSTATIC SCREEN BLANK	2.0 EA	USED ON HEATER VOLTS & ION PUMP METERS #P001 P002
952 9202 170	BOARD, 5 HV METERS SIGMA PLUS	1.0 EA	

WARNING: Disconnect primary power prior to servicing.

Table 7-56. KIT, ASSY, EEV - 992 9830 027

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (d)*
2400-016-00013	GLAND RING 32MM	1.0 EA	UMBILICAL
2400-016-00015	GLAND LOCKNUT 32MM	1.0 EA	UMBILICAL
424 0586 000	HOSE BLACK 2" ID	4.80 FT	CUT 14" & 43"
843 5496 074	SCH, FRT/REAR CAB (EEV)	0.0 EA	
943 5479 015	CABLE, HV UMBILICAL SIGMA PLUS	1.0 EA	
943 5496 035	ASSY, EEV PLUMBING W/FLOW MTR	1.0 EA	
952 9215 170	UMBILICAL CONDUIT	1.0 EA	
992 9826 002	POWER SUPPLY, ISOLATED, 4	1.0 EA	
992 9830 004	METERS, ISO	1.0 EA	

Table 7-57. ASSY, EEV PLUMBING W/FLOW MTR - 943 5496 035

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (c)*
003 8020 040	CU, TBG 1.0 NOM DIA	3.10 FT	
358 3040 000	PLUG, FEMALE 6-HK	1.0 EA	
358 3459 000	PLUG, FEMALE 4-HK	1.0 EA	
359 0228 000	ELBOW 45 DEG, 1" CXC	1.0 EA	
359 0269 000	ADAPTER, MALE	1.0 EA	
359 0660 000	Y 45 DEG 1 IN.	1.0 EA	
359 0975 000	ADAPTER, MALE	1.0 EA	
604 1206 000	SWITCH, LIMIT	2.0 EA	
629 0085 000	FLOW METER, HEDLAND 620-604	1.0 EA	
629 0086 000	FLOW METER, HEDLAND 620-616	1.0 EA	
843 5496 035	ASSY INSTR, EEV PLUMBING	0.0 EA	

Table 7-58. POWER SUPPLY, ISOLATED, 4 - 992 9826 002

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (h)*
041 6030 010	RUBBER CHANNEL X650	2.0 FT	
2422-487-89512	*SIL PAD TO-3 X 0.177M	6.0 EA	
302 0144 100	SCR, 10-32 X 5/8	2.0 EA	C203/C204 BRACKET
354 0032 000	SOLDER LUG 10 MTG HOLE	2.0 EA	
356 0004 000	CABLE CLAMP 1/4 D	2.0 EA	
358 2209 000	U BOLT	2.0 EA	
358 2635 000	CABLE TIE, PUSH MOUNT SNAP IN	2.0 EA	
358 3006 000	STANDOFF, 6-32 X .875	2.0 EA	
358 3132 000	STUD, BRS 1/4-20 1-1/4	3.0 EA	
380 0795 000	TRANSISTOR, POWER, ESD	2.0 EA	V010 V011
380 0796 000	TRANSISTOR, POWER, ESD	4.0 EA	V014 V015 V033 V034
384 0911 000	RECT, BRIDGE SKB60/04 ESD	1.0 EA	
404 0854 000	HEAT SINK BLACK	1.0 EA	
472 1737 000	XFMR, 12VA 20V SEC	1.0 EA	
510 0760 000	CAPACITOR .5MFD -0/+20%	1.0 EA	C202
524 0377 000	CAP 33000UF 25V -10%/+50%	2.0 EA	C203 C204
530 0088 000	BRACKET, CAP, 2" ID	2.0 EA	
542 1654 000	RES 150 OHM 6W 5%	1.0 EA	R215
839 8121 956	SCH, ISO SUPPLY 4 (EEV/CPI)	0.0 EA	
917 2462 053	DISC, CORONA REDUCER	2.0 EA	
917 2462 058	SHIELD, ISOLATED SUPPLIES	1.0 EA	
917 2506 023	MODIFIED CORE ISOLATED P/S	4.0 EA	
917 2506 034	SHIELD, FIBER OPTIC	1.0 EA	
917 2506 048	STANDOFF, ISO PWR SUPPLY	3.0 EA	

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917 2506 126	CABLES, ISO POWER SUPPLY	1.0 EA
922 1297 038	CORONA BUSTER ISOLATED P/S	1.0 EA
922 1297 063	COVER, ISOLATED SUPPLIES 3	1.0 EA
9390-269-10112	*BUSH 56201J (TO-3) INSULA	12.0 EA
943 5496 029	COVER, ISOLATED P/S	1.0 EA
943 5496 070	MTG PLATE ISOLATED P/S, 4	1.0 EA
992 9502 071	*ASSY, 4-PCB, ISO SUPPLY	1.0 EA

Table 7-59. METERS, ISO - 992 9830 004

Harris PN	*Description*	*QTY UM*	*Reference Designators (P)*
335 0012 000	WASHER NYLON .195 ID	4.0 EA	
354 0146 000	LUG SHAKE .176 MTG	11.0 EA	
354 0890 000	TERM, MALE 250 TAB, #6 HOLE	9.0 EA	
357 0071 000	SCREW 10-32 X 1/2	4.0 EA	
358 0960 000	CPLR, 1/4"X1/4" SHAFT	1.0 EA	
384 0888 000	RECT BYW96E 1000V 3A ESD	2.0 EA	
384 0968 000	DIODE, BAW62 ESD	2.0 EA	
410 0022 000	INSULATOR ROUND NS5W0332	2.0 EA	
516 0968 000	CAP 4700PF 5% 100V C0G	4.0 EA	
540 1600 322	RES 7.5K OHM 3W 5%	1.0 EA	R002
552 0997 000	POT 1K OHM 2W 5% 10 TURN	1.0 EA	
560 0095 000	MOV, 130WVAC, 70J, 20MM DISC	1.0 EA	
632 1175 000	MTR, 0-50UA, 90MM W	1.0 EA	
632 1176 000	MTR, 0-150V, 90MM W	1.0 EA	
632 1203 000	METER TO SPEC, 0-10V	1.0 EA	
632 1205 000	METER, BIAS CURRENT	1.0 EA	
917 2501 035	JUMPER PKG, METER, ISO	1.0 EA	
917 2506 016	SHAFT BIAS ADJUST	1.0 EA	
922 1297 048	BIAS, POT MTG BRKT	1.0 EA	
922 1297 049	ELECTROSTATIC SCREEN BLANK	2.0 EA	USED ON HEATER VOLTS & ION PUMP METERS #P001 P002
952 9215 116	BOARD, HV METERS	1.0 EA	
999 2912 001	HARDWARE LIST, METERS, ISO	1.0 EA	

Table 7-60. KIT, CPI FITTINGS - 992 9830 030

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (c)*
358 0935 000	CLAMP, HOSE	4.0 EA	
359 1216 000	COUPLING, FLEXIBLE, 2 X 2	1.0 EA	
424 0586 000	HOSE BLACK 2" ID	7.0 FT	
442 0123 000	THERMOSTAT 155 DEG F N.C.	1.0 EA	
943 5496 073	ASSY, COLLECTOR COOLING, CPI	2.0 EA	

Table 7-61. ASSY, COLLECTOR COOLING, CPI - 943 5496 073

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (b)*
358 0935 000	CLAMP, HOSE	2.0 EA	
358 2718 000	SOCKET, FEMALE 6-HK	1.0 EA	
358 3026 000	HOSE BARB 3/4 H X 3/4 MPT	1.0 EA	
424 0663 000	HOSE 48 IN LG	1.0 EA	
843 5496 073	ASSY INSTR, COLLECTOR COOLING	0.0 EA	

Table 7-62. *KIT, SPARES, PC BOARD, - 994 9797 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (b)*
992 8739 001	*PWA, ANALOG/DIGITAL INTERFACE	1.0 EA	
992 9371 002	*PWA, LOGIC & CONTROL	1.0 EA	
992 9502 071	*ASSY, 4-PCB, ISO SUPPLY	1.0 EA	
992 9881 001	*PWA, AGC & UHF LINEARIZER,	1.0 EA	

Table 7-63. *KIT, SPARE, PARTS - 994 9797 003

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (c)*
396 0251 000	LAMP WEDGE BASE 24V 2W	5.0 EA	
404 0866 000	SKT RELAY 14P PYF14A-E	1.0 EA	
424 0664 000	O-RING,	4.0 EA	
430 0031 000	FAN CARAVEL CL3T2/020191	1.0 EA	
430 0189 000	FAN 24VDC 106CFM	1.0 EA	
430 0239 000	FAN, 24VDC 35.8-49.4 CFM	1.0 EA	
430 0242 000	FAN 230V A/C 50/60HZ	1.0 EA	
430 0249 000	FAN CENTRIFUGAL	1.0 EA	
430 0251 000	FAN CENTRIFUGAL	1.0 EA	
442 0123 000	THERMOSTAT 155 DEG F N.C.	1.0 EA	
448 0963 000	FLTR MEDIA 25" W X 1" THK	85.0 FT	
448 0986 000	FILTER,HIGH EFF,STYLE 192	10.0 EA	
560 0054 000	MOV 4500A 25J 95 VAC	3.0 EA	
560 0095 000	MOV 6000A 50J 130 VAC	3.0 EA	
560 0111 000	VARISTOR 275VAC 140J 275VRMS	3.0 EA	
570 0345 000	CONTACTOR 3 POLE VACUUM	1.0 EA	
570 0346 000	CONTACTOR, 3 POLE 190A	1.0 EA	
570 0347 000	CONTACTOR, 3 POLE 65A	1.0 EA	
570 0353 000	CNTOR 25A 600V 7.5HP 3PH	1.0 EA	
574 0405 000	RELAY 3PDT 120VAC 50/60HZ	1.0 EA	
574 0498 000	RELAY, PHASE PROTECTION	1.0 EA	
574 0503 000	RELAY 110VAC COIL 5A 4PDT	1.0 EA	
578 0028 000	RELAY, CHANGEOVER DPCO	1.0 EA	
578 0029 000	RELAY 12V SPCO RF SW PCB	1.0 EA	
582 0064 000	RELAY, OVERLOAD 2.5-4 AMP	1.0 EA	
584 0318 000	COIL, FOR CA3-12 50/60HZ	5.0 EA	
584 0319 000	CONTACT AUXILIARY	1.0 EA	
584 0331 000	CONTACT BLOCK, AUXILIARY	1.0 EA	
604 0447 000	SW, PRESS.	1.0 EA	
604 0991 000	SW, PB, MOM, SPDT	1.0 EA	
604 1005 000	SW, AIR PRESSURE	1.0 EA	
604 1044 000	SW, INTLK DPDT	1.0 EA	
604 1141 000	SW, PB MEMBRANE SPST	2.0 EA	
604 1150 000	SW SPDT LEVER, GRAY	1.0 EA	
604 1153 000	SWITCH PUSH BUTTON MOM 2P	2.0 EA	
604 1157 000	SW ROTARY 2P 6 POS	1.0 EA	
604 1160 000	SWITCH SQ PUSHBUTTON 1PNO	1.0 EA	
604 1206 000	SWITCH, LIMIT	1.0 EA	
604 1207 000	SWITCH, DISCONNECT	1.0 EA	
606 0876 000	CONTACT AUXILIARY	1.0 EA	
606 0877 000	CKT BREAKER 3A 240VAC	1.0 EA	
606 0878 000	CKT BREAKER 4A 240VAC	1.0 EA	
606 0879 000	CKT BREAKER 6A 240VAC	1.0 EA	
606 0880 000	CKT BREAKER 3A 240VAC	1.0 EA	

606 0900 000	CKT BREAKER 4A 415VAC	1.0 EA
606 0911 000	CKT BREAKER 20A 240VAC 3P	1.0 EA
606 0953 000	CKT BREAKER 15A 3 POLE	1.0 EA
606 0954 000	CKT BREAKER 30A 3 POLE	1.0 EA
606 0957 000	CKT BREAKER 0.25 AMP 1 POLE	1.0 EA
606 0958 000	CKT BREAKER 2 AMP 1 POLE	1.0 EA
606 0959 000	CKT BREAKER 5 AMP 1 POLE	1.0 EA
606 0962 000	CIRCUIT BREAKER 1P 20AMP	1.0 EA
606 0972 000	CKT BREAKER, MICRO CTLR, 3POLE	1.0 EA
629 0085 000	FLOW METER, HEDLAND 620-604	1.0 EA
629 0086 000	FLOW METER, HEDLAND 620-616	1.0 EA

Table 7-64. *KIT, SPARES, SEMICOND & FUSE - 994 9797 004

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (f)*
380 0189 000	XSTR, NPN 2N3904 ESD	12.0 EA	
380 0190 000	XSTR, PNP 2N3906 ESD	12.0 EA	
380 0560 000	TRANSISTOR MPS-A06 ESD	6.0 EA	
380 0747 000	XSTR MPSA42 NPN ESD	6.0 EA	
380 0770 000	XSTR BC547 NPN ESD	6.0 EA	
380 0773 000	XSTR FET BS170 N-CHL ESD	6.0 EA	
382 0184 000	IC, 340T-5/7805 +5V REG ESD	12.0 EA	
382 0371 000	IC, MC7912CT ESD	6.0 EA	
382 0406 000	IC, MC7812CT ESD	6.0 EA	
382 0415 000	IC, 324 ESD	12.0 EA	
382 0452 000	IC, LM311/CA311 ESD	8.0 EA	
382 0593 000	IC TL072ACP ESD	6.0 EA	
382 0594 000	IC TL074ACN ESD	12.0 EA	
382 0734 000	*IC, CA2830C/MHW592 ESD	2.0 EA	
382 0769 000	IC 74HC02 ESD	4.0 EA	
382 0770 000	IC, 74HC04 ESD	12.0 EA	
382 0771 000	IC 74HC08 ESD	12.0 EA	
382 0772 000	IC 74HC10 ESD	12.0 EA	
382 0774 000	IC 74HC14 ESD	12.0 EA	
382 0777 000	IC, 74HC30 ESD	12.0 EA	
382 0778 000	IC, 74HC32 ESD	12.0 EA	
382 0785 000	IC, 74HC86 ESD	12.0 EA	
382 0791 000	IC, 74HC138 ESD	12.0 EA	
382 0793 000	IC, 74HC147 ESD	6.0 EA	
382 0797 000	IC, 74HC157 ESD	6.0 EA	
382 0798 000	IC, 74HC158	6.0 EA	
382 0813 000	IC 74HC240 ESD	12.0 EA	
382 0854 000	IC 74HC4060 ESD	12.0 EA	
382 0856 000	IC 74HC4078 ESD	12.0 EA	
382 0865 000	IC, 74HC4538 ESD	12.0 EA	
382 0882 000	IC, 78L05A ESD	12.0 EA	
382 0897 000	IC ULN2803 ESD	6.0 EA	
382 0899 000	IC, CDP1855CE ESD	2.0 EA	
382 1045 000	IC, 74HC541 ESD	6.0 EA	
382 1081 000	IC 74HC126 ESD	6.0 EA	
382 1160 000	IC 74HC27 (ESD)	6.0 EA	
382 1171 000	IC 74HC540 (ESD)	6.0 EA	
382 1191 000	IC 74HC283 4BIT ADDER ESD	6.0 EA	
382 1244 000	IC CD4043B ESD	6.0 EA	
382 1320 000	IC 79L15AC ESD	6.0 EA	

WARNING: Disconnect primary power prior to servicing.

382 1347 000	IC LP311 ESD	6.0 EA
382 1348 000	IC ICL7665S CMOS ESD	6.0 EA
382 1350 000	IC 74HC4051 CMOS ESD	6.0 EA
382 1360 000	IC 7667 MOSFET DRIVER ESD	2.0 EA
382 1362 000	IC SFH610-2 ESD	2.0 EA
382 1365 000	IC, FIBER OPTIC RCVR ESD	2.0 EA
382 1383 000	IC, FIBER OPTIC XMTR ESD	2.0 EA
382 1395 000	IC, UCN5801A ESD	2.0 EA
382 1400 000	IC, CA5800 ESD	2.0 EA
382 1407 000	IC, ICL7673 ESD	6.0 EA
382 1408 000	IC, X9103P ESD	2.0 EA
382 1410 000	IC, RC4558 ESD	6.0 EA
382 1608 000	IC, ERA-5SM ESD	2.0 EA
382 1633 000	IC, LM333 ESD	2.0 EA
382 1634 000	IC, LT1083CP-12 ESD	2.0 EA
384 0020 000	RECTIFIER IN4005 ESD	12.0 EA
384 0205 000	DIODE SILICON 1N914/4148 ESD	12.0 EA
384 0268 000	RECT 7.5KV PIV 500MA 2W ESD	2.0 EA
384 0307 000	DIODE 1N916 ESD	12.0 EA
384 0431 000	RECT. 1N4001 ESD	12.0 EA
384 0694 000	LED RED CART 12V	3.0 EA
384 0695 000	LED GREEN CART 12V ESD	3.0 EA
384 0702 000	RECT FW BRIDGE 600V 35A ESD	2.0 EA
384 0761 000	BRIDGE, FW 100A 200V ESD	2.0 EA
384 0789 000	DIODE, 5V 500W ESD	6.0 EA
384 0793 000	DIODE, TVS 15V 500W SA15A ESD	6.0 EA
384 0842 000	LED AMBER CART 12V	3.0 EA
384 0880 000	LED, GREEN, RT ANGLE MTG ESD	6.0 EA
384 0888 000	RECT BYW96E 1000V 3A ESD	4.0 EA
384 0889 000	* RECT 2KBP08 800V 2A ESD	4.0 EA
384 0891 000	LED 10 SEG BARGRAPH, GRN ESD	4.0 EA
384 0894 000	DIODE 1N4003G 200V 1A ESD	12.0 EA
384 0895 000	DIODE 1N4007G 1000V 1A ESD	6.0 EA
384 0897 000	RECTIFIER BYW56 1000V 2A ESD	12.0 EA
384 0899 000	RECT 30V .2A BAT85 ESD	6.0 EA
384 0904 000	LED, GRN, T-1 ESD	2.0 EA
384 0911 000	RECT, BRIDGE SKB60/04 ESD	2.0 EA
384 0920 000	RECT, BRIDGE 1A 100V SO ESD	2.0 EA
384 0931 000	RECT, 90SQ045 45V 9A ESD	6.0 EA
384 0966 000	DIODE, SCHOTTKY 40V 100A ESD	3.0 EA
384 0968 000	DIODE, BAW62 ESD	12.0 EA
385 0001 000	DIODE, RECT 4148 / 914 ESD	12.0 EA
385 0027 000	DIODE, 2800 SCHOTTKY SMT ESD	6.0 EA
385 0042 000	RECT BAT 17 4V 30MA ESD	12.0 EA
386 0082 000	ZENER, 1N4744A 15V 1W 5% ESD	12.0 EA
386 0135 000	ZENER, 1N4733A 5.1V ESD	6.0 EA
386 0181 000	ZENER, 1N4739A 9.1V ESD	12.0 EA
386 0298 000	ZENER, 1N5352B 15V ESD	12.0 EA
386 0342 000	ZENER, 1N5333 3.3V ESD	12.0 EA
386 0399 000	ZENER, 1N5231B 5.1V ESD	12.0 EA
386 0401 000	ZENER, 1N5347B 10V ESD	12.0 EA
386 0403 000	ZENER, 1N5257B 33V ESD	12.0 EA
386 0440 000	ZENER, 1N5339B 5.6V 5W 5% ESD	6.0 EA
386 0442 000	ZENER 1N5237B 8.2V 5% ESD	12.0 EA
386 0447 000	TRANSIENT ABSORBER SA28 ESD	12.0 EA

WARNING: Disconnect primary power prior to servicing.

386 0452 000	ZENER, BZX79C3V6 3.6V ESD	12.0 EA
386 0454 000	ZENER, BZX85C15 15V ESD	12.0 EA
386 0459 000	TRANSZORB BZW50-150 150V ESD	6.0 EA
386 1448 000	DIODE, TVS SA18 18V 500W	4.0 EA
387 0010 017	DIODE, TVS 15V 1500W ESD	12.0 EA
398 0054 000	FUSE, SLOW CART 1A 250V	5.0 EA
398 0324 000	FUSE, 1.5A	5.0 EA
398 0368 000	FUSE, CART 2A 600V	3.0 EA
398 0372 000	FUSE, 1A 600V	5.0 EA
398 0476 000	FUSE, 5A, 600V	3.0 EA
398 0485 000	FUSE, SLOW CART .1A 250V	5.0 EA
398 0486 000	FUSE, SLOW CART .25A 250V	5.0 EA
398 0487 000	FUSE, SLOW CART .5A 250V	5.0 EA
398 0488 000	FUSE, SLOW CART 1A 250V	5.0 EA
398 0490 000	FUSE, SLOW CART 5A 250V	5.0 EA
398 0491 000	FUSE, FAST 1A 32V	5.0 EA
398 0492 000	FUSE, FAST 7.5A 32V	5.0 EA
398 0493 000	FUSE, FAST 10A 32V	5.0 EA
398 0494 000	FUSE, FAST CART .25A 250V	5.0 EA
398 0553 000	FUSE, 5 X 30 8A 500V	3.0 EA

Table 7-65. *KIT, SPARES, PC BOARD - 994 9797 007

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (e)*
992 8737 003	*PWA, P/S UNIT DISTRIBUTION	1.0 EA	
992 8739 002	*PWA, DIGITAL & ANALOG INTFC	1.0 EA	
992 8748 002	*PWA, THYROTRON INTERFACE	1.0 EA	
992 8815 002	*PWA, IOT FDU2	1.0 EA	
992 9087 001	*PWA, METER MULTIPLYER	1.0 EA	
992 9363 002	*CONTACTOR DRIVER	1.0 EA	
992 9371 002	*PWA, LOGIC & CONTROL	1.0 EA	
992 9384 001	*PWA, IOT 2 INTERFACE	1.0 EA	
992 9502 048	*PWA, SWITCHED METER	1.0 EA	
992 9502 056	*PWA, FUSE PROTECTION, 15 AMP	1.0 EA	
992 9502 071	*ASSY, 4-PCB, ISO SUPPLY	1.0 EA	
992 9737 043	*PWA, LED DISPLAY	1.0 EA	
992 9737 102	*ASSY, 40 WATT AMP, SIGMA++	1.0 EA	
992 9800 001	PWA, FEED FORWARD REF AMP	1.0 EA	
992 9881 001	*PWA, AGC & UHF LINEARIZER,	1.0 EA	

Table 7-66. *KIT, SPARES, PC BOARD - 994 9797 009

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (b)*
736 0301 000	PWR SUPPLY, LINEAR 12V 3.4AMP	1.0 EA	
736 0305 000	POWER SUPPLY, 24V 3.6A	1.0 EA	
736 0306 000	POWER SUPPLY, 15V 9A	1.0 EA	
736 0307 000	POWER SUPPLY, 15V 3A	1.0 EA	
992 9367 001	*PWA, MARSHALLING	1.0 EA	
992 9502 023	*SYS DISPLAY PCB ASSY (CD)	1.0 EA	
992 9502 067	*SYS INTERFACE PCB ASSY (CD)	1.0 EA	
992 9834 001	*PWA, EXCITER P/S DISTRIBUTION	1.0 EA	

Table 7-67. KIT, SPARES,AMP CAB COMPONENTS - 994 9797 012

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (c)*
358 2718 000	SOCKET, FEMALE 6-HK	1.0 EA	
358 3040 000	PLUG, FEMALE 6-HK	1.0 EA	
358 3459 000	PLUG, FEMALE 4-HK	1.0 EA	
358 3460 000	SOCKET, FEMALE 4-HK	1.0 EA	
378 0180 000	DETECTOR, EEV ARC FOR	1.0 EA	
3913-070-51860	*METER TO SPEC	1.0 EA	
396 0251 000	LAMP WEDGE BASE 24V 2W	5.0 EA	
398 0495 000	FUSE, SLOW CART .2A 250V	2.0 EA	
404 0866 000	SKT RELAY 14P PYF14A-E	1.0 EA	
424 0662 000	HOSE, BODY, EEV MA726B	2.0 EA	
424 0663 000	HOSE 48 IN LG	2.0 EA	
424 0664 000	O-RING,	8.0 EA	
430 0031 000	FAN CARAVEL CL3T2/020191	2.0 EA	
430 0189 000	FAN 24VDC 106CFM	1.0 EA	
430 0234 000	FAN 12VDC 80MM	1.0 EA	
430 0239 000	FAN, 24VDC 35.8-49.4 CFM	1.0 EA	
430 0242 000	FAN 230V A/C 50/60HZ	2.0 EA	
430 0249 000	FAN CENTRIFUGAL	1.0 EA	
430 0251 000	FAN CENTRIFUGAL	1.0 EA	
432 0392 000	BLOWER REGENERATIVE 1HP	1.0 EA	
442 0123 000	THERMOSTAT 155 DEG F N.C.	1.0 EA	
442 0132 000	SWITCH, THERMAL, NO	1.0 EA	
448 0963 000	FLTR MEDIA 25" W X 1" THK	85.0 FT	
448 0986 000	FILTER,HIGH EFF,STYLE 192	10.0 EA	
472 1710 000	XFMR, FIL 8.9V 33A SEC	1.0 EA	
472 1711 000	XFMR, FIL 6.4V 30A SEC	1.0 EA	
472 1715 000	XFMR, PWR, 817-2336-013	1.0 EA	
472 1725 000	XFMR, CNTL, TOROIDAL	1.0 EA	
472 1771 000	*XFMR, GRID BIAS & ION PUMP	1.0 EA	
506 0266 000	CAP 1.0UF 250VAC 10%	1.0 EA	
506 0268 000	CAP, 0.1UF 1600VDC 5%	1.0 EA	
506 0269 000	CAP .1UF 100V 10%	1.0 EA	
506 0270 000	CAP 1UF 400V 10%	1.0 EA	
506 0271 000	CAP .1UF 400V 10%	1.0 EA	
506 0272 000	CAP 2.2UF 100V 10%	1.0 EA	
506 0275 000	CAP 1UF 250V 20%	1.0 EA	
506 0278 000	CAP 0.1UF 1000V 20%	1.0 EA	
508 0581 000	CAP 0.05UF 2000A	1.0 EA	
510 0760 000	CAPACITOR .5MFD -0/+20%	1.0 EA	
516 0985 000	CAP, 100PF 3000V 20%	1.0 EA	
516 0986 000	CAP, 460PF 30KV +80/-20%	1.0 EA	
522 0602 000	CAP 3300UF 25V	1.0 EA	
522 0616 000	CAP 6800UF 50V ELECT	1.0 EA	
524 0349 000	CAP, 880UF 350V	1.0 EA	
524 0363 000	CAP 100UF 385V 20%	1.0 EA	
524 0364 000	CAP 470UF 385V 20%	1.0 EA	
524 0372 000	CAP 220UF 200V +/-20%	1.0 EA	
540 1217 000	RES 22.0 OHM 50W 10%	1.0 EA	
540 1541 000	RES 40 OHM 75W 20% 8"X1"D	1.0 EA	
542 0377 000	RES 60K OHM 5% 225W	1.0 EA	
542 1006 000	RES 5.4 OHM 766W 10%	3.0 EA	
542 1628 000	RES 1 OHM 10% 180W W/W	1.0 EA	
542 1635 000	RES 8.2 OHM 6W 5%	1.0 EA	

WARNING: Disconnect primary power prior to servicing.

542 1636 000	RES 100 OHM 12W 5%	2.0 EA
542 1638 000	RES 470 OHM 12W 5%	2.0 EA
542 1639 000	RES 2.2K OHM 12W 5%	1.0 EA
542 1640 000	RES 3.3K OHM 12W 5%	1.0 EA
542 1641 000	RES 10K OHM 12W 5%	1.0 EA
542 1644 000	RES 10 OHM 2.5W 5%	1.0 EA
542 1645 000	RES 22 OHM 2.5W 5%	1.0 EA
542 1648 000	RES 100 OHM 2.5W 5%	2.0 EA
542 1649 000	RES 4.7K OHM 2.5W 5%	1.0 EA
542 1651 000	RES 4.7K OHM 6W 5%	1.0 EA
542 1652 000	RES 10K OHM 2.5W 5%	1.0 EA
542 1659 000	RES, 0.02 OHM 5% 50W	1.0 EA
544 1668 000	RES 10M OHM 1/4W 5%	1.0 EA
546 0324 000	RES, 25 MEG 45KV 23W 10%	1.0 EA
548 2339 000	RES 15M 1W 1% GC70 SERIES	1.0 EA
552 0999 000	RHEO, DUAL 50 OHM, 100W	2.0 EA
552 1000 000	RHEOSTAT, TANDEM 150 OHM	1.0 EA
560 0059 000	MOV 510VAC 700J 40KA	2.0 EA
560 0095 000	MOV 6000A 50J 130 VAC	1.0 EA
560 0111 000	VARISTOR 275VAC 140J 275VRMS	3.0 EA
570 0353 000	CNTOR 25A 600V 7.5HP 3PH	5.0 EA
574 0502 000	RELAY, SOLID STATE	1.0 EA
574 0503 000	RELAY 110VAC COIL 5A 4PDT	1.0 EA
578 0021 000	RELAY DPDT 12V	2.0 EA
578 0028 000	RELAY, CHANGEOVER DPCO	1.0 EA
578 0029 000	RELAY 12V SPCO RF SW PCB	1.0 EA
582 0064 000	RELAY, OVERLOAD 2.5-4 AMP	1.0 EA
584 0318 000	COIL, FOR CA3-12 50/60HZ	5.0 EA
584 0319 000	CONTACT AUXILIARY	1.0 EA
584 0331 000	CONTACT BLOCK, AUXILIARY	1.0 EA
584 0335 000	CONTACT, AUX DPST (NC/NO)	1.0 EA
604 0447 000	SW, PRESS.	1.0 EA
604 0851 000	SW, RKR 8PST DIP	3.0 EA
604 1005 000	SW, AIR PRESSURE	1.0 EA
604 1044 000	SW, INTLK DPDT	1.0 EA
604 1141 000	SW, PB MEMBRANE SPST	2.0 EA
604 1150 000	SW SPDT LEVER, GRAY	1.0 EA
604 1153 000	SWITCH PUSH BUTTON MOM 2P	2.0 EA
604 1154 000	THERMOSWITCH NC 70 DEG C	2.0 EA
604 1157 000	SW ROTARY 2P 6 POS	1.0 EA
604 1160 000	SWITCH SQ PUSHBUTTON 1PNO	1.0 EA
604 1167 000	SW THERMAL NC 150 DEG C	1.0 EA
604 1168 000	SW MICRO 1POL 10A	2.0 EA
604 1206 000	SWITCH, LIMIT	2.0 EA
606 0876 000	CONTACT AUXILIARY	1.0 EA
606 0877 000	CKT BREAKER 3A 240VAC	6.0 EA
606 0878 000	CKT BREAKER 4A 240VAC	1.0 EA
606 0879 000	CKT BREAKER 6A 240VAC	1.0 EA
606 0880 000	CKT BREAKER 3A 240VAC	1.0 EA
606 0900 000	CKT BREAKER 4A 415VAC	1.0 EA
606 0911 000	CKT BREAKER 20A 240VAC 3P	1.0 EA
606 0957 000	CKT BREAKER 0.25 AMP 1 POLE	1.0 EA
606 0958 000	CKT BREAKER 2 AMP 1 POLE	1.0 EA
606 0959 000	CKT BREAKER 5 AMP 1 POLE	1.0 EA
606 0962 000	CIRCUIT BREAKER 1P 20AMP	3.0 EA

614 0864 000	TERM BLOCK 10POS 750V 26A	1.0 EA
614 0865 000	TERM BLOCK 10POS 750V 34A	1.0 EA
614 0867 000	TERM BLOCK 10POS 750V 34A	1.0 EA
620 0907 000	GAUGE, PRESSURE	1.0 EA
629 0062 000	*FLOW METER, FLOW RANGE	1.0 EA
629 0063 000	*FLOWMETER .5 TO 4.0 GPM	1.0 EA
629 0085 000	FLOW METER, HEDLAND 620-604	1.0 EA
629 0086 000	FLOW METER, HEDLAND 620-616	1.0 EA
632 1174 000	MTR 150-0-150MA 90MM W	1.0 EA
632 1175 000	MTR, 0-50UA, 90MM W	1.0 EA
632 1176 000	MTR, 0-150V, 90MM W	1.0 EA
632 1177 000	MTR, 0-10V, 90MM W	1.0 EA
632 1179 000	MTR, % POWER, 90MM W	2.0 EA
632 1180 000	MTR, % POWER/VSWR 90MM W	1.0 EA
632 1181 000	MTR, 0-50 SCL 120MM W	1.0 EA
632 1203 000	METER TO SPEC, 0-10V	4.0 EA
636 0044 000	METER, ELAPSED TIME	1.0 EA
736 0310 001	PWR SUPPLY, SW, 32V 2700W	1.0 EA
736 0311 000	POWER SUPPLY LINEAR	1.0 EA
917 2506 054	CONNECTOR, BACKPLANE	4.0 EA
943 5479 015	CABLE, HV UMBILICAL SIGMA PLUS	1.0 EA

Table 7-68. *KIT, SPARES, 97KVA BEAM POWER - 994 9797 015

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (a)*
384 0945 000	TRANS-PAK FULLWAVE 6P ESD	1.0 EA	
560 0098 000	SURGE ARRESTER 6KV	1.0 EA	
735 0010 000	ASSY, RESISTOR BD, 60 OHM 225W	1.0 EA	
735 0011 000	BD, INPUT PRIMARY SNUBBER	1.0 EA	
735 0012 000	ASSY, RESISTOR BOARD 20 OHM	1.0 EA	

Table 7-69. KIT, SPARES,FLUID COOLER SIGMA - 994 9797 016

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (a)*
430 0244 000	*FAN BLADES USED ON LIEBERT	2.0 EA	
430 0246 000	FAN MOTOR ASSEMBLY	2.0 EA	
442 0130 000	THERMOSTAT SPDT 55-175F	1.0 EA	
472 1758 000	TRANSFORMER, CONTROL	1.0 EA	
570 0357 000	CONTACTORS, FAN CONTROL	2.0 EA	

Table 7-70. KIT, SPARES, PUMP MODULE - 994 9797 017

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (a)*
358 3456 000	CARTRIDGE FILTER 10MICRON	2.0 EA	
384 0694 000	LED RED CART 12V	2.0 EA	
384 0695 000	LED GREEN CART 12V ESD	4.0 EA	
384 0702 000	RECT FW BRIDGE 600V 35A ESD	1.0 EA	
384 0842 000	LED AMBER CART 12V	1.0 EA	
398 0324 000	FUSE, 1.5A	1.0 EA	
398 0476 000	FUSE, 5A, 600V	3.0 EA	
432 0316 000	PUMP, WATER 60HZ 3 PH	2.0 EA	
442 0041 000	THERMOMETER DIAL	1.0 EA	
472 0622 000	XFMR CTL 115/230V 50/60HZ	1.0 EA	
472 1047 000	XFMR, CTL, STEP DOWN, 1 PHASE	1.0 EA	

560 0035 000	MOV 4500A 35J 130 VAC	2.0 EA
570 0279 000	CNTOR 40A 600V 3P	2.0 EA
574 0156 000	RELAY 12VDC 4PDT	2.0 EA
582 0056 000	RELAY, OVERLOAD 3P 600V	2.0 EA
584 0273 000	HEATER B55	3.0 EA
604 1060 000	SWITCH, TGL DP ON OFF ON	1.0 EA
604 1129 000	SWITCH, LIQUID LEVEL	1.0 EA
604 1170 000	SWITCH, DISCONNECT 480V	2.0 EA
620 2726 000	GAUGE,PRESSURE 3.5IN DIAL	1.0 EA
740 1059 000	MON, PH 430-480V 3PH	1.0 EA

Table 7-71. SYSTEM, CD140P2/CD200P2 - 994 9649 005

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (m)*
051 1010 021	UCARTHERM COOLING FLUID	0.0 EA	QTY AS ORDERED BY CUSTOMER.
378 0170 000	THYRATRON, CERAMIC	0.0 EA	LINE ITEM SPARE
378 0195 000	TUBE, IOT 70KW, WATER COOLED	0.0 EA	LINE ITEM SPARE 70KW TUBE
378 0197 000	TUBE, IOT 110KW, WATER COOLED	0.0 EA	LINE ITEM SPARE 100KW TUBE
378 0218 000	KLYSTRODE, K2D75W	0.0 EA	LINE ITEM SPARE 75KW TUBE
378 0219 000	KLYSTRODE, K2D110W	0.0 EA	LINE ITEM SPARE 110KW TUBE
432 0410 000	FLUID COOLER 3 FAN	1.0 EA	
620 2817 000	MOTORIZED SWITCH OPTION	0.0 EA	OPTION ORDER QTY 1
620 2950 000	ADAPTER, DIELECTRIC TO MYAT	0.0 EA	ORDER QTY 2 FOR DIELECTRIC RF SYSTEM
620 3047 000	RF SYSTEM DTV 2-TUBE PASSIVE	0.0 EA	PASSIVE POWER PROD, QTY 1 FOR CH 14-40
620 3048 000	RF SYSTEM DTV 2-TUBE PASSIVE	0.0 EA	PASSIVE POWER PROD, QTY 1 FOR CH 41-69
620 3056 000	RF SYS DTV 2-TUBE DIELECTRIC	0.0 EA	DIELECTRIC, ORDER QTY 1 FOR CH 14-17
620 3057 000	RF SYS DTV 2-TUBE DIELECTRIC	0.0 EA	DIELECTRIC, ORDER QTY 1 FOR CH 18-43
620 3058 000	RF SYS DTV 2-TUBE DIELECTRIC	0.0 EA	DIELECTRIC, ORDER QTY 1 FOR CH 44-69
736 0322 000	POWER SUPPLY BEAM 480VAC 96KVA	2.0 EA	
952 9211 200	KIT, WATER PLUMBING 2 TUBE	1.0 EA	
988 2414 200	DP, 2-TUBE, CD140P2/CD200P2	2.0 EA	
988 8641 001	*DP, SIGMA+ IPA W/FEED FORWARD	2.0 EA	
992 6742 005	GLYCOL PUMP MODULE, IOT	1.0 EA	
992 8724 001	LINE CNTL CAB, 480V 60HZ	2.0 EA	
992 8734 001	*MODULE, 1KW S.S. AMPLIFIER	0.0 EA	LINE ITEM SPARE
992 8807 001	INSTALL MATL, 2-TUBE IOT	1.0 EA	
992 8812 001	CALORIMETRY ASSEMBLY	0.0 EA	#OPTION, ORDER QTY 1
992 9139 013	KIT, INSTALLATION, 4" LINE	0.0 EA	
992 9508 001	ASSY, AUTO-CHANGEOVER CTLR	0.0 EA	ORDER QTY 1 FOR AUTO PUMP CHANGE-OVER
992 9511 067	INTERCONNECT CABLES, 2-TUBE CD	1.0 EA	
994 9649 001	*XMTR, 2-TUBE, SIGMA	0.0 EA	
994 9649 004	XMTR-Q, CD140P2/CD200P2	0.0 EA	ORDER 1 FOR QUINCY BUILT, QUINCY WILL FORMAT TO CHANNEL
994 9797 001	*KIT, SPARES, PC BOARD,	0.0 EA	
994 9797 003	*KIT, SPARE, PARTS	0.0 EA	
994 9797 004	*KIT, SPARES, SEMICOND & FUSE	0.0 EA	
994 9797 007	*KIT, SPARES, PC BOARD	0.0 EA	
994 9797 009	*KIT, SPARES, PC BOARD	0.0 EA	
994 9797 012	KIT, SPARES,AMP CAB COMPONENTS	0.0 EA	
994 9797 013	KIT, SPARES, LINE CONTROL CAB	0.0 EA	
994 9797 015	*KIT, SPARES, 97KVA BEAM POWER	0.0 EA	

WARNING: Disconnect primary power prior to servicing.

994 9797 016	KIT, SPARES,FLUID COOLER SIGMA	0.0 EA	
994 9797 017	KIT, SPARES, PUMP MODULE	0.0 EA	
HEW8482H	HEWLETT PACKARD SENSOR PROBE	0.0 EA	OPTION ORDER QTY 1.
HEWEPM-441A	POWER METER, RF	0.0 EA	OPTION ORDER QTY 1.

Table 7-72. KIT, WATER PLUMBING 2 TUBE - 952 9211 200

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (n)*
003 8020 040	CU, TBG 1.0 NOM DIA	0.0 FT	80 REQ'D
003 8020 060	CU, TBG 2.0 NOM DIA	0.0 FT	120 REQ'D
086 0004 038	SOLDER, SILVER SIZE 0.062	0.0 LB	1 REQ'D
086 0004 040	* STAY CLEAN FLUX	0.0 EA	1 REQ'D
086 0004 047	SOLDER, SILVER SIZE .125"	0.0 LB	1 REQ'D
299 0018 000	THREAD-TAPE, TEFLON	0.0 RL	1 REQ'D
358 1722 000	CLAMP, ADJ, SIZE 20	0.0 EA	16 REQ'D
358 3038 000	HOSE BARB 1" H X 1" MPT	0.0 EA	8 REQ'D
358 3348 000	HOSE CAP, 3/4 HOSE THD.	0.0 EA	5 REQ'D
359 0085 000	PLUG, PIPE BRASS	0.0 EA	1 REQ'D
359 0192 000	ELBOW, 90 DEG 1" CXC	0.0 EA	16 REQ'D
359 0193 000	TEE 1 IN	0.0 EA	4 REQ'D
359 0197 000	ADAPTER FEMALE FITTING	0.0 EA	8 REQ'D, #HOSE BARBS
359 0199 000	UNION, 1" CXC	0.0 EA	4 REQ'D, #AMPLIFIER CABINETS
359 0200 000	ELBOW, 90 DEG STREET	0.0 EA	(OPTIONAL)
359 0225 000	ADAPTER 1" C X 1" M	0.0 EA	4 REQ'D, #DIELECTRIC LOADS
359 0228 000	ELBOW 45 DEG, 1" CXC	0.0 EA	8 REQ'D
359 0250 000	ADAPTER, FEMALE	0.0 EA	10 REQ'D, #HOSE BARBS
359 0251 000	VALVE, GATE 1"CXC BRONZE	0.0 EA	4 REQ'D, #TOP OF AMPLIFIER CABINETS
359 0260 000	ELBOW 45 DEG 2 IN	0.0 EA	2 REQ'D
359 0272 000	ELBOW, 90 DEG 2" CXC	0.0 EA	20 REQ'D
359 0302 000	ELBOW 90 DEG STREET	0.0 EA	2 REQ'D
359 0321 000	PLUG PIPE 1/8 NPT	0.0 EA	(#CALORIMETRIC TEST LOAD)
359 0324 000	VALVE GLOBE 1" CXC BRONZE	0.0 EA	4 REQ'D, #TEST/REJECT LOADS
359 0355 000	ADAPTOR 3/4 - 1/2	0.0 EA	5 REQ'D
359 0434 000	UNION C X M 2 IN	0.0 EA	2 REQ'D, #USED WITH BALANCE SETTER VALVE.
359 0476 000	ADAPTER 2" CXM	0.0 EA	1 REQ'D
359 0477 000	UNION, 2" CXC	0.0 EA	2 REQ'D
359 0479 000	VALVE, GATE 2" CXC	0.0 EA	3 REQ'D
359 0480 000	UNION 2 IN C X 2FPT	0.0 EA	2 REQ'D
359 0514 000	ADAPTER 2 IN	0.0 EA	1 REQ'D
359 0594 000	UNION, 3/4 CXM CAST	0.0 EA	4 REQ'D
359 0829 000	UNION 1" CXM	0.0 EA	10 REQ'D
359 0869 000	REDUCER FTG 2-1/2" X 2"	0.0 EA	1 REQ'D
359 0883 000	ADPTR, FTG 1" FTG X 1/2"F	0.0 EA	2 REQ'D
359 0884 000	TEE, 2"CX2"CX1"C	0.0 EA	6 REQ'D
359 0891 000	TEE, 1 X 1/8 X 1	0.0 EA	2 REQ'D, (#CALORIMETRIC TEST LOAD)
359 0923 000	ELBOW 90 DEG 2 X 1 CXC	0.0 EA	2 REQ'D
359 0942 000	VALVE, BALANCE/SETTER 2"	0.0 EA	1 REQ'D
359 0962 000	REDUCER, 2" FTG X 1" C	0.0 EA	2 REQ'D
359 0984 000	REGULATOR, PRESS REDUCING	0.0 EA	2 REQ'D
359 0997 000	BOILER DRAIN, 1/2"	0.0 EA	5 REQ'D
359 1042 000	TEE 2"X2"X3/4" COPPER	0.0 EA	5 REQ'D
359 1075 000	ADAPTER FTG X M 1 X 3/4	0.0 EA	4 REQ'D, #PASSIVE PWR LOAD
359 1079 000	TEE 1X1X 3/4 CXCXC	0.0 EA	2 REQ'D, #TEST/REJECT LOADS
359 1083 000	NIPPLE, 2" NPT X 6"L	0.0 EA	1 REQ'D

WARNING: Disconnect primary power prior to servicing.

359 1128 000	ADAPTER 3/4 X 1 C X F	0.0 EA	4 REQ'D
359 1236 000	ELBOW, 2" STREET45	0.0 EA	1 REQ'D
424 0469 000	HOSE SIL RUB 1" X 12' LG	1.0 EA	
432 0410 000	FLUID COOLER 3 FAN	0.0 EA	SEE NEXT LEVEL B/M
442 0108 000	THERMOSTAT 185 DEG F N.C.	2.0 EA	
629 0059 000	FLOW MTR, 15GPM, 1" FNPT	2.0 EA	
646 1488 000	LABEL, CAUTION	2.0 EA	
852 9211 200	LAYOUT, WATER PLUMBING	0.0 EA	
917 2336 066	ADAPTER THERMOSTAT	2.0 EA	
917 2336 112	LABEL INSTRUCTIONS,	1.0 EA	
952 9211 203	KIT, SUB ASSY PLUMBING, 2 TUBE	1.0 EA	
992 6742 005	GLYCOL PUMP MODULE, IOT	0.0 EA	SEE NEXT LEVEL B/M

Table 7-73. INSTALL MATL, 2-TUBE IOT - 992 8807 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (u)*
003 4010 050	CU, STRAP .020 X 4"	157.50 FT	
296 0350 000	TUBING, ZIPPER .625	200.0 FT	
302 0532 000	SCR, 1/2-13 X 1-1/4	16.0 EA	
308 0013 000	WASHER, FLAT 1/2	16.0 EA	
314 0015 000	WASHER, SPLIT-LOCK 1/2	16.0 EA	
354 0005 000	TERM LUG RED SPADE 6	50.0 EA	
354 0006 000	TERM LUG RED SPADE 8	50.0 EA	
354 0011 000	LUG BLUE RING .25	50.0 EA	
354 0015 000	LUG BLUE SPADE 6	50.0 EA	
354 0016 000	LUG BLUE SPADE 8	50.0 EA	
354 0017 000	LUG BLUE SPADE 10	50.0 EA	
354 0027 000	TERM LUG YEL SPADE 8	50.0 EA	
354 0245 000	TERM LUG YEL RING 10	50.0 EA	
354 0254 000	LUG .25 RING YEL	10.0 EA	
354 0325 000	LUG,.25 RING YEL 12-10AWG	10.0 EA	
354 0338 000	LUG 4 RING RED	50.0 EA	
354 0700 000	LUG 3/8 RING FOR 18-14AWG	10.0 EA	
358 3192 000	EYEBOLT, 1/2-13 THDS.	8.0 EA	
464 0242 000	CHAIN HOIST 10 FT, 1 TON	1.0 EA	
464 0253 000	PLIERS, ZIPPER TUBING	1.0 EA	
614 0842 000	TERM BLOCK 4POS 380V 8A	4.0 EA	
614 0844 000	TERM BLOCK 10POS 380V 8A	7.0 EA	
690 0016 000	DUCT SEALANT, PUTTY	1.0 BX	
917 2336 023	CABINET CLAMP	6.0 EA	
917 2336 024	CABINET CLAMP	2.0 EA	
917 2501 102	INSTL MTL, WIRE, USA 60/80KW	1.0 EA	
922 1311 003	CLAMP, CABINET INSTALLATION,	2.0 EA	# SIGMA CDII
992 3660 001	KIT, HARDWARE	1.0 EA	
992 9830 032	KIT, LINEARIZER INP ATTENUATOR	2.0 EA	
994 8442 001	KIT, PROBE (1.50); 6-1/8 LINE	2.0 EA	
994 8442 006	KIT, PROBE (1.25); 4-1/16 LINE	2.0 EA	

Table 7-74. KIT, INSTALLATION, 4" LINE - 992 9139 013

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (g)*
041 1310 013	RUBBER SPONGE 3/8	10.0 FT	#PIPE HANGERS
086 0004 038	SOLDER, SILVER SIZE 0.062	2.0 LB	
086 0004 040	* STAY CLEAN FLUX	1.0 EA	

086 0004 060	SOLDER, HARD SILVER, 1/16DIA	1.80 TZ
302 0318 000	SCR, 3/8-16 X 1.0	120.0 EA
302 0319 000	SCR, 3/8-16 X 1-1/4	0.0 EA
302 0320 000	SCR, 3/8-16 X 1-1/2	120.0 EA
302 0338 000	SCR, 1/2-13 X 1-1/2	120.0 EA
306 0034 000	NUT, HEX 1/2-13	180.0 EA
306 0047 000	NUT, HEX 3/8-16	180.0 EA
310 0011 000	WASHER, FLAT 3/8	180.0 EA
310 0026 000	WASHER, FLAT 1/2	180.0 EA
314 0011 000	WASHER, SPLIT-LOCK 3/8	180.0 EA
314 0015 000	WASHER, SPLIT-LOCK 1/2	180.0 EA
358 1127 000	ANGLE FITTING 90 DEG	23.0 EA
358 1131 000	NUT W/SPRING 3/8-16	60.0 EA
358 1891 000	ANCHOR SCREW 3/8-16	0.0 EA
358 1895 000	NUT W/SPRING 1/2-13	20.0 EA
358 1896 000	ROD 1/2-13 THREADED	20.0 EA
358 2160 000	CHANNEL 1-5/8 SQ 20 FT LG	10.0 EA
358 2188 000	FLAT PLATE FITTING	50.0 EA
358 2202 000	NUT COUPLER 3/8-16	10.0 EA
358 2472 000	FLAT PLATE FITTING	10.0 EA
358 3038 000	HOSE BARB 1" H X 1" MPT	2.0 EA
358 3565 000	CLAMP, PIPING, WITH CUSHION	14.0 EA
358 3598 000	ANGLE, UNISTRUT, 45 DEGREE	2.0 EA
358 3700 000	CLAMP, PIPING, WITH CUSHION	10.0 EA
359 1049 000	PIPE HANGER 2IN LAY-IN	4.0 EA
359 1051 000	PIPE HANGER 4IN LAY-IN	10.0 EA
359 1053 000	PIPE HANGER 2.0IN LAY-IN	0.0 EA
359 1055 000	PIPE HANGER 4.0IN LAY-IN	0.0 EA
464 0055 000	SETTING TOOL	0.0 EA
464 0056 000	DRILL MASONARY	0.0 EA
690 0017 000	PIPE JOINT COMPOUND	1.0 EA

Table 7-75. XMTR-Q, CD140P2/CD200P2 - 994 9649 004

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (ak)*
378 0196 000	IOT AND CIRCUIT ASSEMBLY 70KW	0.0 EA	ORDER QTY 2 FOR CD140P2 OR DROP SHIPMENTS. EEV
378 0198 000	IOT AND CIRCUIT ASSEMBLY 110KW	0.0 EA	ORDER QTY 2 FOR CD200P2 OR DROP SHIPMENTS. EEV
378 0213 000	KLYSTRODE, CDK2750W3	0.0 EA	ORDER QTY 2 FOR CD140P2 OR DROP SHIPMENTS. CPI
378 0214 000	KLYSTRODE, CDK2110W3	0.0 EA	ORDER QTY 2 FOR CD200P2 OR DROP SHIPMENTS. CPI
3913-466-56810	3DB COUPLER LO POWER BD5	0.0 EA	SELECT TWO FOR 626-860 MHZ
3913-466-59680	*3DB COUPLER LO POWER BD4	0.0 EA	SELECT TWO FOR 470-636 MHZ
432 0393 000	BLOWER REGENERATIVE 2.5HP	0.0 EA	
484 0441 000	BREAKAWAY/FILTER, 470-596 MHZ	0.0 EA	ORDER QTY 2 FOR CH 14-34
484 0442 000	BREAKAWAY/FILTER, 596-704 MHZ	0.0 EA	ORDER QTY 2 FOR CH 35-52
484 0443 000	BREAKAWAY/FILTER, 704-862 MHZ	0.0 EA	ORDER QTY 2 FOR CH 53-69
484 0461 000	FILTER, LOW PASS 700MHZ	0.0 EA	ORDER QTY 2 FOR CH 14 TO 43
484 0462 000	FILTER, LOW PASS 1000MHZ	0.0 EA	ORDER QTY 2 FOR CH 44 TO 78
618 0731 000	LINE, ADJ CONSTANT Z	1.0 EA	FOR CONTROL CABINET PH ADJ 1
620 2957 008	CIRCULATOR, UHF	0.0 EA	ORDER QTY 4 FOR FEED FWD CH 14-26
620 2957 009	CIRCULATOR, UHF	0.0 EA	ORDER QTY 4 FOR FEED FWD CH 27-44
620 2957 010	CIRCULATOR, UHF	0.0 EA	ORDER QTY 4 FOR FEED FWD CH 45-69

WARNING: Disconnect primary power prior to servicing.

620 2957 011	CIRCULATOR, UHF	0.0 EA	ORDER QTY 4 FOR FEED FWD CH 70-77
620 2974 000	CIRCULATOR, 470-547 MHZ	0.0 EA	ORDER QTY: 8 FOR SINGLE IPA, 16 FOR DUAL IPA, CH 14-26
620 2975 000	*CIRCULATOR, 537-636 MHZ	0.0 EA	ORDER 8 FOR SINGLE IPA, 16 FOR DUAL IPA CH 27-40
620 2976 000	*CIRCULATOR, 626-740 MHZ	0.0 EA	ORDER 8 FOR SINGLE IPA, 16 FOR DUAL IPA, CH 41-57
620 2977 000	*CIRCULATOR, 730-860 MHZ	0.0 EA	ORDER 8 FOR SINGLE IPA, 16 FOR DUAL IPA, CH 58-77
917 2300 133	NAMEPLATE, XMTR FCC SERIAL	1.0 EA	
992 8813 001	*ASSY, MODE CONTROLLER	1.0 EA	
992 9821 001	CABINET, REAR, SIGMA+	2.0 EA	
992 9822 002	CABINET, FRONT, LINEAR, SIGMA+	2.0 EA	
992 9824 002	CABINET, CONTROL (CD1A)	1.0 EA	
992 9830 002	KIT, EEV FITTINGS	0.0 EA	ORDER 2 FOR EEV TUBES
992 9830 016	KIT, SINGLE IPA	0.0 EA	ORDER QTY 2 WHEN USED WITH EEV 70KW ALL CHANNELS, EEV 100KW CH-26 AND LOWER
992 9830 017	KIT, DUAL IPA	0.0 EA	ORDER QTY 2 WHEN USED WITH CPI ALL POWERS & CHANNELS EEV 100KW CH 27 AND UP
992 9830 020	KIT, DUAL EXCITER	0.0 EA	ORDER QTY 1 FOR DUAL EXCITER
992 9830 021	KIT, SINGLE EXCITER	0.0 EA	ORDER QTY 1 FOR SINGLE EXCITER
992 9830 026	KIT, CPI ASSY	0.0 EA	ORDER 2 FOR CPI TUBES
992 9830 027	KIT, ASSY, EEV	0.0 EA	ORDER 2 FOR EEV TUBES
992 9830 030	KIT, CPI FITTINGS	0.0 EA	ORDER 2 FOR CPI TUBES
994 9785 001	EXCITER,CD-1A UHF OR VHF TUNED	0.0 EA	ORDER 1 FOR SINGLE EXCITER, ORDER 2 FOR DUAL EXCITERS, QUINCY WILL FORMAT TO CHANNEL

Table 7-76. SYSTEM, CD210P3/CD300P3 - 994 9650 005

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (m)*
051 1010 021	UCARTHERM COOLING FLUID	0.0 EA	QTY AS ORDERED BY CUSTOMER.
378 0170 000	THYRATRON, CERAMIC	0.0 EA	LINE ITEM SPARE
378 0195 000	TUBE, IOT 70KW, WATER COOLED	0.0 EA	LINE ITEM SPARE 70KW TUBE
378 0197 000	TUBE, IOT 110KW, WATER COOLED	0.0 EA	LINE ITEM SPARE 100KW TUBE
378 0218 000	KLYSTRODE, K2D75W	0.0 EA	LINE ITEM SPARE 75KW TUBE
378 0219 000	KLYSTRODE, K2D110W	0.0 EA	LINE ITEM SPARE 110KW TUBE
432 0445 000	FLUID COOLER 4-FAN LO-FLOW	1.0 EA	
620 2817 000	MOTORIZED SWITCH OPTION	0.0 EA	OPTION ORDER QTY 1
620 2950 000	ADAPTER, DIELECTRIC TO MYAT	0.0 EA	ORDER QTY 3 FOR DIELECTRIC RF SYSTEM
620 3049 000	RF SYSTEM DTV 3-TUBE PASSIVE	0.0 EA	PASSIVE POWER PROD, QTY 1 FOR CH 14-40
620 3050 000	RF SYSTEM DTV 3-TUBE PASSIVE	0.0 EA	PASSIVE POWER PROD, QTY 1 FOR CH 41-69
620 3059 000	RF SYS DTV 3-TUBE DIELECTRIC	0.0 EA	DIELECTRIC, ORDER QTY 1 FOR CH 14-17
620 3060 000	RF SYS DTV 3-TUBE DIELECTRIC	0.0 EA	DIELECTRIC, ORDER QTY 1 FOR CH 18-43
620 3061 000	RF SYS DTV 3-TUBE DIELECTRIC	0.0 EA	DIELECTRIC, ORDER QTY 1 FOR CH 44-69
736 0322 000	POWER SUPPLY BEAM 480VAC 96KVA	3.0 EA	
952 9211 300	KIT, WATER PLUMBING 3 TUBE	1.0 EA	
988 2414 300	DP, 3-TUBE, CD210P3/CD300P3	2.0 EA	
988 8641 001	*DP, SIGMA+ IPA W/FEED FORWARD	2.0 EA	
992 6742 008	PUMP MODULE, 55 GAL TANK	1.0 EA	
992 8724 001	LINE CNTL CAB, 480V 60HZ	3.0 EA	

WARNING: Disconnect primary power prior to servicing.

992 8734 001	*MODULE, 1KW S.S. AMPLIFIER	0.0 EA	LINE ITEM SPARE
992 8808 001	INSTALL MATL, 3-TUBE IOT	1.0 EA	
992 8812 001	CALORIMETRY ASSEMBLY	0.0 EA	#OPTION, ORDER QTY 1
992 9139 014	KIT, INSTALLATION, 4" LINE	0.0 EA	
992 9508 001	ASSY, AUTO-CHANGEOVER CTLR	0.0 EA	ORDER QTY 1 FOR AUTO PUMP CHANGE-OVER
992 9511 068	INTERCONNECT CABLES, 3-TUBE CD	1.0 EA	
994 9650 001	*XMTR, 3-TUBE, SIGMA	0.0 EA	
994 9650 004	XMTR-Q, CD210P3/CD300P3	0.0 EA	ORDER 1 FOR QUINCY BUILT, QUINCY WILL FORMAT TO CHANNEL
994 9797 001	*KIT, SPARES, PC BOARD,	0.0 EA	
994 9797 003	*KIT, SPARE, PARTS	0.0 EA	
994 9797 004	*KIT, SPARES, SEMICOND & FUSE	0.0 EA	
994 9797 007	*KIT, SPARES, PC BOARD	0.0 EA	
994 9797 009	*KIT, SPARES, PC BOARD	0.0 EA	
994 9797 012	KIT, SPARES,AMP CAB COMPONENTS	0.0 EA	
994 9797 013	KIT, SPARES, LINE CONTROL CAB	0.0 EA	
994 9797 015	*KIT, SPARES, 97KVA BEAM POWER	0.0 EA	
994 9797 016	KIT, SPARES,FLUID COOLER SIGMA	0.0 EA	
994 9797 017	KIT, SPARES, PUMP MODULE	0.0 EA	
HEW8482H	HEWLETT PACKARD SENSOR PROBE	0.0 EA	OPTION ORDER QTY 1.
HEWEPM-441A	POWER METER, RF	0.0 EA	OPTION ORDER QTY 1.

Table 7-77. KIT, WATER PLUMBING 3 TUBE - 952 9211 300

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (q)*
003 8020 040	CU, TBG 1.0 NOM DIA	0.0 FT	90 FT REQ'D
003 8020 060	CU, TBG 2.0 NOM DIA	0.0 FT	20 REQ'D
003 8020 065	CU, TBG 2.5 NOM DIA	0.0 FT	200 FT REQ'D
086 0004 038	SOLDER, SILVER SIZE 0.062	0.0 LB	1# REQ'D
086 0004 040	* STAY CLEAN FLUX	0.0 EA	1 REQ'D
086 0004 047	SOLDER, SILVER SIZE .125"	0.0 LB	1# REQ'D
299 0018 000	THREAD-TAPE, TEFLON	0.0 RL	1 REQ'D
358 1722 000	CLAMP, ADJ, SIZE 20	0.0 EA	24 REQ'D
358 3038 000	HOSE BARB 1" H X 1" MPT	0.0 EA	12 REQ'D
358 3348 000	HOSE CAP, 3/4 HOSE THD.	0.0 EA	5 REQ'D
359 0085 000	PLUG, PIPE BRASS	0.0 EA	2 REQ'D
359 0192 000	ELBOW, 90 DEG 1" CXC	0.0 EA	26 REQ'D
359 0193 000	TEE 1 IN	0.0 EA	6 REQ'D
359 0197 000	ADAPTER FEMALE FITTING	0.0 EA	12 REQ'D, #HOSE BARBS
359 0199 000	UNION, 1" CXC	0.0 EA	6 REQ'D, #AMPLIFIER CABINETS
359 0200 000	ELBOW, 90 DEG STREET	0.0 EA	OPTIONAL
359 0206 000	ELBOW, 90 DEG 2-1/2"	0.0 EA	OPTIONAL
359 0225 000	ADAPTER 1" C X 1" M	0.0 EA	6 REQ'D, #DIELECTRIC LOADS
359 0228 000	ELBOW 45 DEG, 1" CXC	0.0 EA	12 REQ'D
359 0250 000	ADAPTER, FEMALE	0.0 EA	12 REQ'D, #HOSE BARBS
359 0251 000	VALVE, GATE 1"CXC BRONZE	0.0 EA	6 REQ'D, #TOP OF AMPLIFIER CABINET
359 0272 000	ELBOW, 90 DEG 2" CXC	0.0 EA	4 REQ'D
359 0302 000	ELBOW 90 DEG STREET	0.0 EA	2 REQ'D
359 0321 000	PLUG PIPE 1/8 NPT	0.0 EA	(#CALORIMETRIC TEST LOAD)
359 0324 000	VALVE GLOBE 1" CXC BRONZE	0.0 EA	6 REQ'D, #TEST, REJECT LOADS
359 0355 000	ADAPTOR 3/4 - 1/2	0.0 EA	5 REQ'D
359 0419 000	ELBOW 90 DEG 2-1/2	0.0 EA	20 REQ'D
359 0420 000	ELBOW 45 DEG 2-1/2	0.0 EA	2 REQ'D

WARNING: Disconnect primary power prior to servicing.

359 0422 000	ADAPTER 2-1/2	0.0 EA	1 REQ'D
359 0433 000	UNION C X C 2-1/2 IN	0.0 EA	1 REQ'D
359 0475 000	VALVE, GATE	0.0 EA	2 REQ'D
359 0477 000	UNION, 2" CXC	0.0 EA	1 REQ'D
359 0479 000	VALVE, GATE 2" CXC	0.0 EA	1 REQ'D
359 0480 000	UNION 2 IN C X 2FPT	0.0 EA	2 REQ'D
359 0532 000	COUPLING 2-1/2 X 1	0.0 EA	2 REQ'D
359 0574 000	TEE 2-1/2C x 2-1/2C x 1C	0.0 EA	10 REQ'D
359 0594 000	UNION, 3/4 CXM CAST	0.0 EA	6 REQ'D
359 0658 000	COUPLING 2-1/2 IN.	0.0 EA	6 REQ'D
359 0829 000	UNION 1" CXM	0.0 EA	14 REQ'D
359 0869 000	REDUCER FTG 2-1/2" X 2"	0.0 EA	1 REQ'D
359 0891 000	TEE, 1 X 1/8 X 1	0.0 EA	(#CALORIMETRIC TEST LOAD)
359 0935 000	UNION 2-1/2 CXM	0.0 EA	2 REQ'D, #USE WITH BALANCE SETTER VALVE.
359 0939 000	TEE, 2-1/2CX2-1/2CX3/4C	0.0 EA	4 REQ'D
359 0984 000	REGULATOR, PRESS REDUCING	0.0 EA	3 REQ'D
359 0997 000	BOILER DRAIN, 1/2"	0.0 EA	5 REQ'D
359 1042 000	TEE 2"X2"X3/4" COPPER	0.0 EA	1 REQ'D
359 1075 000	ADAPTER FTG X M 1 X 3/4	0.0 EA	6 REQ'D, #PASSIVE PWR LOADS
359 1079 000	TEE 1X1X 3/4 CXCXC	0.0 EA	3 REQ'D
359 1084 000	NIPPLE 2 1/2" NPT X 6"	0.0 EA	1 REQ'D
359 1117 000	ADAPTOR 2-1/2 IN CXF (CAST)	0.0 EA	1 REQ'D
359 1128 000	ADAPTER 3/4 X 1 C X F	0.0 EA	6 REQ'D
359 1138 000	VALVE, BALANCE/SETTER 2-1/2"	0.0 EA	1 REQ'D
359 1236 000	ELBOW, 2" STREET45	0.0 EA	1 REQ'D
424 0469 000	HOSE SIL RUB 1" X 12' LG	2.0 EA	
432 0445 000	FLUID COOLER 4-FAN LO-FLOW	0.0 EA	
442 0108 000	THERMOSTAT 185 DEG F N.C.	3.0 EA	
629 0059 000	FLOW MTR, 15GPM, 1" FNPT	2.0 EA	
629 0069 000	FLOW MTR, 30GPM, 1" FNPT	1.0 EA	
646 1488 000	LABEL, CAUTION	3.0 EA	
852 9211 300	LAYOUT, WATER PLUMBING	0.0 EA	
917 2336 066	ADAPTER THERMOSTAT	3.0 EA	
917 2336 112	LABEL INSTRUCTIONS,	1.0 EA	
952 9211 303	KIT, SUB ASSY PLUMBING, 3 TUBE	1.0 EA	
992 6742 005	GLYCOL PUMP MODULE, IOT	0.0 EA	
992 8812 001	CALORIMETRY ASSEMBLY	0.0 EA	OPTION

Table 7-78. PUMP MODULE, 55 GAL TANK - 992 6742 008

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (g)*
003 8020 113	TUBING POLYPROPYLENE	7.0 FT	
026 6010 001	NYLON, PROFILE .500 WIDE	0.750 FT	
041 1310 025	RUB SILICONE SPONGE	0.1140 RL	
041 1310 030	GASKET, RUBBER	10.670 FT	#BETWEEN FRONT PANELS
055 0120 230	CONDUIT 3/4 IN.	6.0 FT	
055 0120 232	CONN, STRAIGHT 3/4	2.0 EA	
055 0120 319	CONN 90 DEG INSULATED 3/4	2.0 EA	
063 1030 021	* PIPE SEALANT "PST"	0.0 EA	#USE AS REQ
335 0106 000	WASHER PLAIN .187 ID	4.0 EA	K007
354 0197 000	CONNECTOR SET SCREW TYPE	12.0 EA	#PUMPS
357 0038 000	BUSHING TEFLON	2.0 EA	#U001
358 1316 000	CLAMP, ADJ, SIZE 24	2.0 EA	#PIPE MTG ANGLES
358 1761 000	CLAMP ADJ.	2.0 EA	#PIPE MTG ANGLES

358 1823 000	CLAMP, ADJ, SIZE 48	2.0 EA	#PIPE MTG ANGLES
358 1974 000	SPEED NUT 10-32	44.0 EA	
358 2426 000	PLUG, WHITE 2" HOLE	4.0 EA	
358 2635 000	CABLE TIE, PUSH MOUNT SNAP IN	23.0 EA	USED AS TIES FOR CABLE
358 3348 000	HOSE CAP, 3/4 HOSE THD.	2.0 EA	
358 3456 000	CARTRIDGE FILTER 10MICRON	2.0 EA	
358 3463 000	SEAL, TOGGLE SWITCH	1.0 EA	
358 3612 000	PLATE, BARRIER (282, 2-COND)	1.0 EA	#TB001
358 3637 000	PLATE, END STOP, DIN RAIL MTG	2.0 EA	#TB001
359 0495 000	SNUBBER, PRESSURE	1.0 EA	
359 1068 000	BULKHEAD FITTING 2"	2.0 EA	#TANK OUTLET INLET
359 1122 000	CONNECTOR, FEMALE	1.0 EA	#M001
359 1123 000	ELBOW MALE SWIVEL 90 DEG	1.0 EA	#M001
382 0296 000	IC, LM340K-12 ESD	1.0 EA	U001
384 0431 000	RECT. 1N4001 ESD	2.0 EA	CR002 CR003
384 0694 000	LED RED CART 12V	2.0 EA	DS005 DS006
384 0695 000	LED GREEN CART 12V ESD	4.0 EA	DS001 DS002 DS003 DS004
384 0702 000	RECT FW BRIDGE 600V 35A ESD	1.0 EA	CR001
384 0842 000	LED AMBER CART 12V	1.0 EA	DS007
398 0324 000	FUSE, 1.5A	1.0 EA	F001
398 0476 000	FUSE, 5A, 600V	3.0 EA	F002 F003 F004
402 0024 000	FUSE HOLDER	1.0 EA	XF001
402 0130 000	FUSE HOLDER, 3 POLE	1.0 EA	XF002 3 4
404 0578 000	SOCKET RELAY, 4PDT	2.0 EA	XK003 XK004
404 0661 000	SOCKET, TRANSISTOR TO-3	1.0 EA	XU001
404 0695 000	HEAT SINK FOR TO-3 CASE	1.0 EA	#U001
410 0391 000	INSULATOR TRANSISTOR T03	1.0 EA	#U001
424 0033 000	GROMMET 1-1/16 MTG D	3.0 EA	
424 0382 000	WASHER, RUBBER	1.0 EA	#LEVEL SW
432 0316 000	PUMP, WATER 60HZ 3 PH	2.0 EA	B001 B002
442 0041 000	THERMOMETER DIAL	1.0 EA	M002
448 0224 000	HANDLE ALUM	1.0 EA	
472 0622 000	XFMR CTL 115/230V 50/60HZ	1.0 EA	T002
472 1047 000	XFMR, CTL, STEP DOWN, 1 PHASE	1.0 EA	T001
522 0531 000	CAP 1UF 50V 20%	1.0 EA	C003
524 0147 000	CAP 2600UF 50V	1.0 EA	C002
524 0150 000	CAP 6000 UF 50V	1.0 EA	C001
530 0088 000	BRACKET, CAP, 2" ID	1.0 EA	#C001
530 0094 000	BRACKET, CAP, 1.375"ID	1.0 EA	#C002
540 0287 000	* RES 13 OHM 1W 5%	1.0 EA	R002
540 0611 000	* RES 1K OHM 2W 5%	1.0 EA	R001
560 0035 000	MOV 4500A 35J 130 VAC	2.0 EA	RV001 RV002
570 0279 000	CNTOR 40A 600V 3P	2.0 EA	K001 K002
574 0156 000	RELAY 12VDC 4PDT	2.0 EA	K003
			K004
582 0056 000	RELAY, OVERLOAD 3P 600V	2.0 EA	K005 K006
584 0273 000	HEATER B55	6.0 EA	HR001 HR002 HR003 HR004 HR005 HR006
604 1060 000	SWITCH, TGL DP ON OFF ON	1.0 EA	S001
604 1129 000	SWITCH, LIQUID LEVEL	1.0 EA	S002
604 1170 000	SWITCH, DISCONNECT 480V	2.0 EA	
614 0048 000	TERM BD 4 TERM	1.0 EA	TB003
614 0059 000	TERM BD 15 TERM	1.0 EA	TB002
614 0132 000	TERM STRIP 2 TERM	1.0 EA	TS001
614 0718 000	JUMPER MODEL 601-J/141J	2.0 EA	
614 0915 000	TERM BLK, 2C MODULAR 282	7.0 EA	#TB001

WARNING: Disconnect primary power prior to servicing.

614 0920 000	JUMPER, 2-POLE ADJACENT 282	3.0 EA	#TB001
614 0921 010	MARKER STRIP, TERM BLK, 1-10	1.0 EA	#TB001
620 2726 000	GAUGE,PRESSURE 3.5IN DIAL	1.0 EA	M001
646 0665 000	INSPECTION LABEL	1.0 EA	
646 1483 000	HARRIS NAMEPLATE	1.0 EA	
740 1059 000	MON, PH 430-480V 3PH	1.0 EA	K007
817 2336 123	RUNNING SHT, PUMP MODULE	0.0 EA	
822 0218 001	STRAP, GND	1.0 EA	
822 0741 039	BRKT, U1 MTG	1.0 EA	#XU001
843 5396 221	WIRING DIAG, PUMP MODULE,	0.0 EA	
852 9188 101	OUTLINE, PUMP MODULE, 55 GAL	0.0 EA	
922 0965 152	FITTING, LEVEL SWITCH	2.0 EA	
922 0965 153	SHIELD, LEVEL SWITCH	1.0 EA	
922 1295 019	SHIELD, DEFLECTOR	1.0 EA	TB003
922 1297 054	RAIL, 4"	1.0 EA	#TB001
943 4578 001	PUMP DISCHARGE ASSY	1.0 EA	
952 9188 098	TANK, MODIFIED, 55 GAL	1.0 EA	
952 9188 100	ASSY, TANK RETURN, 55 GAL TANK	1.0 EA	#TANK OUTLET
952 9190 600	CABINET ASSY	1.0 EA	
952 9190 607	VORTEX PLATE 2" OUTLET	1.0 EA	
952 9190 608	ENCLOSURE, TOP TANK	1.0 EA	
952 9190 611	PUMP INLET ASSY	1.0 EA	
952 9190 618	ANGLE PIPE SUPPORT	5.0 EA	#PIPE SUPPORTS
952 9190 619	TOP ELECTRICAL PANEL	1.0 EA	
952 9190 620	PANEL, LOWER ELECTRICAL	1.0 EA	
952 9190 627	SIDE PANELS	2.0 EA	
952 9190 628	BLANK PANEL	1.0 EA	
952 9190 630	CABLE ASSY	1.0 EA	
994 9659 011	KIT, ADVANCED SPARES PUMP	0.0 EA	
999 2418 001	HARDWARE LIST, PUMP MODULE	1.0 EA	
999 2819 001	WIRE/TUBING LIST	1.0 EA	

Table 7-79. INSTALL MATL, 3-TUBE IOT - 992 8808 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (s)*
003 4010 050	CU, STRAP .020 X 4"	210.0 FT	
296 0350 000	TUBING, ZIPPER .625	300.0 FT	
302 0532 000	SCR, 1/2-13 X 1-1/4	24.0 EA	
308 0013 000	WASHER, FLAT 1/2	24.0 EA	
314 0015 000	WASHER, SPLIT-LOCK 1/2	24.0 EA	
354 0005 000	TERM LUG RED SPADE 6	75.0 EA	
354 0006 000	TERM LUG RED SPADE 8	75.0 EA	
354 0011 000	LUG BLUE RING .25	75.0 EA	
354 0015 000	LUG BLUE SPADE 6	75.0 EA	
354 0016 000	LUG BLUE SPADE 8	75.0 EA	
354 0017 000	LUG BLUE SPADE 10	75.0 EA	
354 0027 000	TERM LUG YEL SPADE 8	75.0 EA	
354 0245 000	TERM LUG YEL RING 10	75.0 EA	
354 0254 000	LUG .25 RING YEL	15.0 EA	
354 0325 000	LUG,.25 RING YEL 12-10AWG	15.0 EA	
354 0338 000	LUG 4 RING RED	75.0 EA	
354 0567 000	TERMINAL 3/8 RING	15.0 EA	
354 0700 000	LUG 3/8 RING FOR 18-14AWG	15.0 EA	
358 3192 000	EYEBOLT, 1/2-13 THDS.	12.0 EA	
464 0242 000	CHAIN HOIST 10 FT, 1 TON	1.0 EA	

464 0253 000	PLIERS, ZIPPER TUBING	1.0 EA	
614 0842 000	TERM BLOCK 4POS 380V 8A	4.0 EA	
614 0844 000	TERM BLOCK 10POS 380V 8A	8.0 EA	
690 0016 000	DUCT SEALANT, PUTTY	1.0 BX	
917 2336 023	CABINET CLAMP	9.0 EA	
917 2336 024	CABINET CLAMP	3.0 EA	
917 2501 101	INSTL MTL, WIRE, USA 90/120KW	1.0 EA	
922 1311 003	CLAMP, CABINET INSTALLATION,	2.0 EA	# SIGMA CDII
992 3660 001	KIT, HARDWARE	1.0 EA	
992 9830 032	KIT, LINEARIZER INP ATTENUATOR	3.0 EA	
994 8442 001	KIT, PROBE (1.50); 6-1/8 LINE	3.0 EA	
994 8442 006	KIT, PROBE (1.25); 4-1/16 LINE	3.0 EA	

Table 7-80. KIT, INSTALLATION, 4" LINE - 992 9139 014

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (g)*
041 1310 013	RUBBER SPONGE 3/8	10.0 FT	
086 0004 038	SOLDER, SILVER SIZE 0.062	3.0 LB	
086 0004 040	* STAY CLEAN FLUX	2.0 EA	
086 0004 060	SOLDER, HARD SILVER, 1/16DIA	2.70 TZ	
302 0318 000	SCR, 3/8-16 X 1.0	120.0 EA	
302 0319 000	SCR, 3/8-16 X 1-1/4	120.0 EA	
302 0320 000	SCR, 3/8-16 X 1-1/2	120.0 EA	
302 0338 000	SCR, 1/2-13 X 1-1/2	120.0 EA	
306 0034 000	NUT, HEX 1/2-13	250.0 EA	
306 0047 000	NUT, HEX 3/8-16	250.0 EA	
310 0011 000	WASHER, FLAT 3/8	250.0 EA	
310 0026 000	WASHER, FLAT 1/2	250.0 EA	
314 0011 000	WASHER, SPLIT-LOCK 3/8	250.0 EA	
314 0015 000	WASHER, SPLIT-LOCK 1/2	250.0 EA	
358 1127 000	ANGLE FITTING 90 DEG	30.0 EA	
358 1131 000	NUT W/SPRING 3/8-16	90.0 EA	
358 1891 000	ANCHOR SCREW 3/8-16	0.0 EA	
358 1895 000	NUT W/SPRING 1/2-13	25.0 EA	
358 1896 000	ROD 1/2-13 THREADED	25.0 EA	
358 2160 000	CHANNEL 1-5/8 SQ 20 FT LG	12.0 EA	
358 2188 000	FLAT PLATE FITTING	50.0 EA	
358 2202 000	NUT COUPLER 3/8-16	15.0 EA	
358 2472 000	FLAT PLATE FITTING	15.0 EA	
358 3038 000	HOSE BARB 1" H X 1" MPT	2.0 EA	
358 3570 000	PIPE CLAMP WITH CUSHION	15.0 EA	
358 3598 000	ANGLE, UNISTRUT, 45 DEGREE	2.0 EA	
358 3700 000	CLAMP, PIPING, WITH CUSHION	15.0 EA	
359 1049 000	PIPE HANGER 2IN LAY-IN	6.0 EA	
359 1051 000	PIPE HANGER 4IN LAY-IN	12.0 EA	
359 1053 000	PIPE HANGER 2.0IN LAY-IN	0.0 EA	
359 1055 000	PIPE HANGER 4.0IN LAY-IN	0.0 EA	
464 0055 000	SETTING TOOL	0.0 EA	
464 0056 000	DRILL MASONARY	0.0 EA	
690 0017 000	PIPE JOINT COMPOUND	1.0 EA	

WARNING: Disconnect primary power prior to servicing.

Table 7-81. XMTR-Q, CD210P3/CD300P3 - 994 9650 004

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (y)*
378 0196 000	IOT AND CIRCUIT ASSEMBLY 70KW	0.0 EA	ORDER QTY 3 FOR CD210P3 OR DROP SHIPMENTS. EEV
378 0198 000	IOT AND CIRCUIT ASSEMBLY 110KW	0.0 EA	ORDER QTY 3 FOR CD300P3 OR DROP SHIPMENTS. EEV
378 0213 000	KLYSTRODE, CDK2750W3	0.0 EA	ORDER QTY 3 FOR CD210P3 OR DROP SHIPMENTS. CPI
378 0214 000	KLYSTRODE, CDK2110W3	0.0 EA	ORDER QTY 3 FOR CD300P3 OR DROP SHIPMENTS. CPI
3913-466-56810	3DB COUPLER LO POWER BD5	0.0 EA	SELECT THREE FOR 626-860 MHZ
3913-466-59680	*3DB COUPLER LO POWER BD4	0.0 EA	SELECT THREE FOR 470-636 MHZ
432 0393 000	BLOWER REGENERATIVE 2.5HP	0.0 EA	CHOOSE 3 FOR HIGH ALT.
484 0441 000	BREAKAWAY/FILTER, 470-596 MHZ	0.0 EA	ORDER QTY 3 FOR CH 14-34
484 0442 000	BREAKAWAY/FILTER, 596-704 MHZ	0.0 EA	ORDER QTY 3 FOR CH 35-52
484 0443 000	BREAKAWAY/FILTER, 704-862 MHZ	0.0 EA	ORDER QTY 3 FOR CH 53-69
484 0461 000	FILTER, LOW PASS 700MHZ	0.0 EA	ORDER QTY 3 FOR CH 14 TO 43
484 0462 000	FILTER, LOW PASS 1000MHZ	0.0 EA	ORDER QTY 3 FOR CH 44 TO 78
620 2957 008	CIRCULATOR, UHF	0.0 EA	ORDER QTY 6 FOR FEED FWD CH 14-26
620 2957 009	CIRCULATOR, UHF	0.0 EA	ORDER QTY 6 FOR FEED FWD CH 27-44
620 2957 010	CIRCULATOR, UHF	0.0 EA	ORDER QTY 6 FOR FEED FWD CH 45-69
620 2957 011	CIRCULATOR, UHF	0.0 EA	ORDER QTY 6 FOR FEED FWD CH 70-77
620 2974 000	CIRCULATOR, 470-547 MHZ	0.0 EA	ORDER QTY 12 FOR SINGLE IPA, 24 FOR DUAL IPA, CH 14-26
620 2975 000	*CIRCULATOR, 537-636 MHZ	0.0 EA	ORDER 12 FOR SINGLE IPA, 24 FOR DUAL IPA, CH 27-40
620 2976 000	*CIRCULATOR, 626-740 MHZ	0.0 EA	ORDER 12 FOR SINGLE IPA, 24 FOR DUAL IPA CH 41-57
620 2977 000	*CIRCULATOR, 730-860 MHZ	0.0 EA	ORDER 12 FOR SINGLE IPA, 24 FOR DUAL IPA, CH 58-77
917 2300 133	NAMEPLATE, XMTR FCC SERIAL	1.0 EA	
917 2506 111	KIT, PHASING, 3-AMP	1.0 EA	USED IN CONTROL CABINET
992 8813 001	*ASSY, MODE CONTROLLER	1.0 EA	
992 9821 001	CABINET, REAR, SIGMA+	3.0 EA	
992 9822 002	CABINET, FRONT, LINEAR, SIGMA+	3.0 EA	
992 9824 002	CABINET, CONTROL (CD1A)	1.0 EA	
992 9830 002	KIT, EEV FITTINGS	0.0 EA	ORDER 3 FOR EEV TUBES
992 9830 016	KIT, SINGLE IPA	0.0 EA	ORDER QTY 3 WHEN USED WITH EEV 70KW ALL CHANNELS, EEV 100KW CH 26 AND LOWER
992 9830 017	KIT, DUAL IPA	0.0 EA	ORDER QTY 3 WHEN USED WITH CPI ALL POWERS & CHANNELS EEV 100KW CH 27 AND UP
992 9830 020	KIT, DUAL EXCITER	0.0 EA	ORDER QTY 1 FOR DUAL EXCITER
992 9830 021	KIT, SINGLE EXCITER	0.0 EA	ORDER QTY 1 FOR SINGLE EXCITER
992 9830 026	KIT, CPI ASSY	0.0 EA	ORDER 3 FOR CPI TUBES
992 9830 027	KIT, ASSY, EEV	0.0 EA	ORDER 3 FOR EEV TUBES
992 9830 030	KIT, CPI FITTINGS	0.0 EA	ORDER 3 FOR CPI TUBES
994 9785 001	EXCITER,CD-1A UHF OR VHF TUNED	0.0 EA	ORDER 1 FOR SINGLE EXCITER, ORDER 2 FOR DUAL EXCITERS, QUINCY WILL FORMAT TO CHANNEL

WARNING: Disconnect primary power prior to servicing.

Table 7-82. KIT, PHASING, 3-AMP - 917 2506 111

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (a)*
2411-027-07102	PLUG RF INC CBL SCR RG223	3.0 EA	W062 W063
2413-031-10255	ADPT RF INC F-F FREE 50R	2.0 EA	
2432-020-00237	ADPT RF INC M-M FREE 50R	2.0 EA	
384 0307 000	DIODE 1N916 ESD	2.0 EA	
3913-009-00920	RELAY 12 VOLT	2.0 EA	K001 K002
618 0731 000	LINE, ADJ CONSTANT Z	2.0 EA	PH ADJ 1, PH ADJ 2
620 2966 000	PLUG, TNC, RG223 CRIMP	2.0 EA	W062 W063 PHASE CABLES AS REQUIRED
917 2506 113	CABLE, COAX JUMPER PACKAGE	1.0 EA	W060 W061 W062 W063 W064

Table 7-83. SYSTEM, CD280P4/CD400P4 - 994 9651 005

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (l)*
051 1010 021	UCARTHERM COOLING FLUID	0.0 EA	QTY AS ORDERED BY CUSTOMER.
378 0170 000	THYRATRON, CERAMIC	0.0 EA	LINE ITEM SPARE
378 0195 000	TUBE, IOT 70KW, WATER COOLED	0.0 EA	LINE ITEM SPARE 70KW TUBE
378 0197 000	TUBE, IOT 110KW, WATER COOLED	0.0 EA	LINE ITEM SPARE 100KW TUBE
378 0218 000	KLYSTRODE, K2D75W	0.0 EA	LINE ITEM SPARE 75KW TUBE
378 0219 000	KLYSTRODE, K2D110W	0.0 EA	LINE ITEM SPARE 110KW TUBE
432 0410 000	FLUID COOLER 3 FAN	2.0 EA	
620 2817 000	MOTORIZED SWITCH OPTION	0.0 EA	OPTION ORDER QTY 1
620 2950 000	ADAPTER, DIELECTRIC TO MYAT	0.0 EA	ORDER QTY 4 FOR DIELECTRIC RF SYSTEM
620 3051 000	RF SYSTEM DTV 4-TUBE PASSIVE	0.0 EA	PASSIVE POWER PROD, QTY 1 FOR CH 14-40
620 3052 000	RF SYSTEM DTV 4-TUBE PASSIVE	0.0 EA	PASSIVE POWER PROD, QTY 1 FOR CH 41-69
620 3062 000	RF SYS DTV 4-TUBE DIELECTRIC	0.0 EA	DIELECTRIC, ORDER QTY 1 FOR CH 14-17
620 3063 000	RF SYS DTV 4-TUBE DIELECTRIC	0.0 EA	DIELECTRIC, ORDER QTY 1 FOR CH 18-43
620 3064 000	RF SYS DTV 4-TUBE DIELECTRIC	0.0 EA	DIELECTRIC, ORDER QTY 1 FOR CH 44-69
736 0322 000	POWER SUPPLY BEAM 480VAC 96KVA	4.0 EA	
952 9211 400	KIT, WATER PLUMBING 4 TUBE	1.0 EA	
988 2414 400	DP, 4-TUBE, CD280P4/CD400P4	2.0 EA	
988 8641 001	*DP, SIGMA+ IPA W/FEED FORWARD	2.0 EA	
992 6742 005	GLYCOL PUMP MODULE, IOT	2.0 EA	
992 8724 001	LINE CNTL CAB, 480V 60HZ	4.0 EA	
992 8734 001	*MODULE, 1KW S.S. AMPLIFIER	0.0 EA	LINE ITEM SPARE
992 8809 001	INSTALL MATL, 4-TUBE IOT	1.0 EA	
992 8812 001	CALORIMETRY ASSEMBLY	0.0 EA	
992 9139 015	KIT, INSTALLATION, 4" LINE	0.0 EA	
992 9508 001	ASSY, AUTO-CHANGEOVER CTLR	0.0 EA	ORDER QTY 1 FOR AUTO PUMP CHANGE-OVER
992 9511 069	INTERCONNECT CABLES, 4-TUBE CD	1.0 EA	
994 9651 001	*XMTR, 4-TUBE, SIGMA	0.0 EA	
994 9651 004	XMTR-Q, CD280P4/CD400P4	0.0 EA	ORDER 1 FOR QUINCY BUILT, QUINCY WILL FORMAT TO CHANNEL
994 9797 001	*KIT, SPARES, PC BOARD,	0.0 EA	
994 9797 003	*KIT, SPARE, PARTS	0.0 EA	
994 9797 004	*KIT, SPARES, SEMICOND & FUSE	0.0 EA	
994 9797 007	*KIT, SPARES, PC BOARD	0.0 EA	
994 9797 009	*KIT, SPARES, PC BOARD	0.0 EA	
994 9797 012	KIT, SPARES,AMP CAB COMPONENTS	0.0 EA	
994 9797 013	KIT, SPARES, LINE CONTROL CAB	0.0 EA	
994 9797 015	*KIT, SPARES, 97KVA BEAM POWER	0.0 EA	

WARNING: Disconnect primary power prior to servicing.

994 9797 016	KIT, SPARES,FLUID COOLER SIGMA	0.0 EA	
994 9797 017	KIT, SPARES, PUMP MODULE	0.0 EA	
HEW8482H	HEWLETT PACKARD SENSOR PROBE	0.0 EA	OPTION ORDER QTY 1.
HEWEPM-441A	POWER METER, RF	0.0 EA	OPTION ORDER QTY 1.

Table 7-84. KIT, WATER PLUMBING 4 TUBE - 952 9211 400

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (j)*
003 8020 040	CU, TBG 1.0 NOM DIA	0.0 FT	80 REQ
003 8020 050	CU, TBG 1.5 NOM DIA	0.0 FT	10 REQ, #3-WAY VALVE
003 8020 060	CU, TBG 2.0 NOM DIA	0.0 FT	40 REQ
003 8020 065	CU, TBG 2.5 NOM DIA	0.0 FT	250 REQ
086 0004 038	SOLDER, SILVER SIZE 0.062	0.0 LB	1 REQ
086 0004 040	* STAY CLEAN FLUX	0.0 EA	1 REQ
086 0004 047	SOLDER, SILVER SIZE .125"	0.0 LB	2 REQ'D
299 0018 000	THREAD-TAPE, TEFLON	0.0 RL	2 REQ'D
358 1722 000	CLAMP, ADJ, SIZE 20	0.0 EA	32 REQ
358 3038 000	HOSE BARB 1" H X 1" MPT	0.0 EA	16 REQ
358 3348 000	HOSE CAP, 3/4 HOSE THD.	0.0 EA	10 REQ, #BOILER DRAIN VALVE
359 0085 000	PLUG, PIPE BRASS	0.0 EA	4 REQ'D
359 0192 000	ELBOW, 90 DEG 1" CXC	0.0 EA	40 REQ
359 0193 000	TEE 1 IN	0.0 EA	8 REQ, #REJECT/TEST LOAD
359 0197 000	ADAPTER FEMALE FITTING	0.0 EA	16 REQ'D, #REJECT/TEST LOAD
359 0199 000	UNION, 1" CXC	0.0 EA	8 REQ'D, 2 PER AMPLIFIER CABINETS
359 0200 000	ELBOW, 90 DEG STREET	0.0 EA	OPTIONAL
359 0206 000	ELBOW, 90 DEG 2-1/2"	0.0 EA	OPTIONAL
359 0213 000	TEE, 1 X 1 X 1-1/2	0.0 EA	2 REQ
359 0225 000	ADAPTER 1" C X 1" M	0.0 EA	9 REQ, #REJECT/TEST LOAD
359 0226 000	ADAPTER 1-1/2 CXM	0.0 EA	2 REQ, #3-WAY VALVE
359 0228 000	ELBOW 45 DEG, 1" CXC	0.0 EA	32 REQ'D, #TOP OF AMPLIFIER CABINET
359 0246 000	ELBOW, 90 DEG 1-1/2 CXC	0.0 EA	3 REQ
359 0250 000	ADAPTER, FEMALE	0.0 EA	16 REQ, #USED WITH HOSE BARBS
359 0251 000	VALVE, GATE 1"CXC BRONZE	0.0 EA	8 REQ, #TOP OF AMPLIFIER CABINET
359 0260 000	ELBOW 45 DEG 2 IN	0.0 EA	4 REQ
359 0272 000	ELBOW, 90 DEG 2" CXC	0.0 EA	10 REQ
359 0302 000	ELBOW 90 DEG STREET	0.0 EA	2 REQ'D
359 0321 000	PLUG PIPE 1/8 NPT	0.0 EA	(#CALORIMETRIC TEST LOAD)
359 0324 000	VALVE GLOBE 1" CXC BRONZE	0.0 EA	8 REQ, #REJECT/TEST LOADS
359 0355 000	ADAPTOR 3/4 - 1/2	0.0 EA	10 REQ
359 0403 000	COUPLING 1" CXC	0.0 EA	8 REQ
359 0419 000	ELBOW 90 DEG 2-1/2	0.0 EA	34 REQ
359 0435 000	UNION C X M 1-1/2 IN	0.0 EA	4 REQ, #3-WAY VALVE
359 0475 000	VALVE, GATE	0.0 EA	2 REQ
359 0476 000	ADAPTER 2" CXM	0.0 EA	2 REQ
359 0477 000	UNION, 2" CXC	0.0 EA	6 REQ'D
359 0479 000	VALVE, GATE 2" CXC	0.0 EA	4 REQ
359 0480 000	UNION 2 IN C X 2FPT	0.0 EA	2 REQ'D
359 0514 000	ADAPTER 2 IN	0.0 EA	2 REQ
359 0531 000	TEE 2.5 X 2.5 X 1.5	0.0 EA	4 REQ, #3-WAY VALVE
359 0532 000	COUPLING 2-1/2 X 1	0.0 EA	4 REQ
359 0574 000	TEE 2-1/2C x 2-1/2C x 1C	0.0 EA	8 REQ
359 0594 000	UNION, 3/4 CXM CAST	0.0 EA	8 REQ, #REJECT/TEST LOADS
359 0829 000	UNION 1" CXM	0.0 EA	18 REQ
359 0860 000	VALVE,3-WAY BALL 1-1/2NPT	0.0 EA	2 REQ

WARNING: Disconnect primary power prior to servicing.

359 0891 000	TEE, 1 X 1/8 X 1	0.0 EA	(#CALORIMETRIC TEST LOAD)
359 0905 000	COUPLING,2-1/2 X 2 W/STOP	0.0 EA	2 REQ'D
359 0935 000	UNION 2-1/2 CXM	0.0 EA	4 REQ'D, #USED WITH BALANCE SETTER VALVE
359 0939 000	TEE, 2-1/2CX2-1/2CX3/4C	0.0 EA	6 REQ'D
359 0984 000	REGULATOR, PRESS REDUCING	0.0 EA	4 REQ, #REJECT/TEST LOADS
359 0997 000	BOILER DRAIN, 1/2"	0.0 EA	10 REQ
359 1042 000	TEE 2"X2"X3/4" COPPER	0.0 EA	4 REQ'D
359 1075 000	ADAPTER FTG X M 1 X 3/4	0.0 EA	8 REQ, #USED WITH PASSIVE POWER LOADS
359 1083 000	NIPPLE, 2" NPT X 6"L	0.0 EA	2 REQ
359 1128 000	ADAPTER 3/4 X 1 C X F	0.0 EA	8 REQ, #REJECT/TEST LOADS
359 1138 000	VALVE, BALANCE/SETTER 2-1/2"	0.0 EA	2 REQ'D, #MAY OR MAY NOT BE USED
359 1236 000	ELBOW, 2" STREET45	0.0 EA	1 REQ'D
424 0469 000	HOSE SIL RUB 1" X 12' LG	3.0 EA	
432 0410 000	FLUID COOLER 3 FAN	0.0 EA	SEE NEXT LEVEL B/M
442 0108 000	THERMOSTAT 185 DEG F N.C.	4.0 EA	#REJECT/TEST LOAD
629 0059 000	FLOW MTR, 15GPM, 1" FNPT	3.0 EA	#REJECT LOADS
629 0069 000	FLOW MTR, 30GPM, 1" FNPT	1.0 EA	#TEST LOADS
646 1488 000	LABEL, CAUTION	4.0 EA	
852 9211 400	LAYOUT, WATER PLUMBING	0.0 EA	
917 2336 066	ADAPTER THERMOSTAT	4.0 EA	#REJECT/TEST LOAD
917 2336 112	LABEL INSTRUCTIONS,	2.0 EA	
952 9211 403	KIT, SUB ASSY PLUMBING, 4 TUBE	1.0 EA	
992 6742 005	GLYCOL PUMP MODULE, IOT	0.0 EA	SEE NEXT LEVEL B/M

Table 7-85. INSTALL MATL, 4-TUBE IOT - 992 8809 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (r)*
003 4010 050	CU, STRAP .020 X 4"	262.50 FT	
296 0350 000	TUBING, ZIPPER .625	400.0 FT	
302 0532 000	SCR, 1/2-13 X 1-1/4	32.0 EA	
308 0013 000	WASHER, FLAT 1/2	32.0 EA	
314 0015 000	WASHER, SPLIT-LOCK 1/2	32.0 EA	
354 0005 000	TERM LUG RED SPADE 6	100.0 EA	
354 0006 000	TERM LUG RED SPADE 8	100.0 EA	
354 0011 000	LUG BLUE RING .25	100.0 EA	
354 0015 000	LUG BLUE SPADE 6	100.0 EA	
354 0016 000	LUG BLUE SPADE 8	100.0 EA	
354 0017 000	LUG BLUE SPADE 10	100.0 EA	
354 0027 000	TERM LUG YEL SPADE 8	100.0 EA	
354 0245 000	TERM LUG YEL RING 10	100.0 EA	
354 0254 000	LUG .25 RING YEL	20.0 EA	
354 0325 000	LUG,.25 RING YEL 12-10AWG	20.0 EA	
354 0338 000	LUG 4 RING RED	100.0 EA	
354 0567 000	TERMINAL 3/8 RING	20.0 EA	
354 0700 000	LUG 3/8 RING FOR 18-14AWG	20.0 EA	
358 3192 000	EYEBOLT, 1/2-13 THDS.	16.0 EA	
464 0242 000	CHAIN HOIST 10 FT, 1 TON	1.0 EA	
464 0253 000	PLIERS, ZIPPER TUBING	1.0 EA	
614 0842 000	TERM BLOCK 4POS 380V 8A	4.0 EA	
614 0844 000	TERM BLOCK 10POS 380V 8A	9.0 EA	
690 0016 000	DUCT SEALANT, PUTTY	1.0 BX	
917 2336 023	CABINET CLAMP	12.0 EA	
917 2336 024	CABINET CLAMP	4.0 EA	

WARNING: Disconnect primary power prior to servicing.

917 2501 100	INSTL MTL, WIRE, USA 120/160KW	1.0 EA	
922 1311 003	CLAMP, CABINET INSTALLATION,	2.0 EA	# SIGMA CDII
943 5396 105	*KIT OF CABLES RF & CONTROL	1.0 EA	
992 3660 001	KIT, HARDWARE	2.0 EA	
992 9830 032	KIT, LINEARIZER INP ATTENUATOR	4.0 EA	
994 8442 001	KIT, PROBE (1.50); 6-1/8 LINE	4.0 EA	
994 8442 006	KIT, PROBE (1.25); 4-1/16 LINE	4.0 EA	

Table 7-86. KIT, INSTALLATION, 4" LINE - 992 9139 015

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (g)*
041 1310 013	RUBBER SPONGE 3/8	10.0 FT	
086 0004 038	SOLDER, SILVER SIZE 0.062	4.0 LB	
086 0004 040	* STAY CLEAN FLUX	2.0 EA	
086 0004 060	SOLDER, HARD SILVER, 1/16DIA	2.70 TZ	
302 0318 000	SCR, 3/8-16 X 1.0	150.0 EA	
302 0319 000	SCR, 3/8-16 X 1-1/4	0.0 EA	
302 0320 000	SCR, 3/8-16 X 1-1/2	150.0 EA	
302 0338 000	SCR, 1/2-13 X 1-1/2	150.0 EA	
306 0034 000	NUT, HEX 1/2-13	250.0 EA	
306 0047 000	NUT, HEX 3/8-16	250.0 EA	
310 0011 000	WASHER, FLAT 3/8	250.0 EA	
310 0026 000	WASHER, FLAT 1/2	250.0 EA	
314 0011 000	WASHER, SPLIT-LOCK 3/8	250.0 EA	
314 0015 000	WASHER, SPLIT-LOCK 1/2	250.0 EA	
358 1127 000	ANGLE FITTING 90 DEG	35.0 EA	
358 1131 000	NUT W/SPRING 3/8-16	120.0 EA	
358 1891 000	ANCHOR SCREW 3/8-16	0.0 EA	
358 1895 000	NUT W/SPRING 1/2-13	25.0 EA	
358 1896 000	ROD 1/2-13 THREADED	30.0 EA	
358 2160 000	CHANNEL 1-5/8 SQ 20 FT LG	15.0 EA	
358 2188 000	FLAT PLATE FITTING	60.0 EA	
358 2202 000	NUT COUPLER 3/8-16	15.0 EA	
358 2472 000	FLAT PLATE FITTING	20.0 EA	
358 3038 000	HOSE BARB 1" H X 1" MPT	2.0 EA	
358 3570 000	PIPE CLAMP WITH CUSHION	25.0 EA	
358 3598 000	ANGLE, UNISTRUT, 45 DEGREE	2.0 EA	
358 3700 000	CLAMP, PIPING, WITH CUSHION	12.0 EA	
359 1049 000	PIPE HANGER 2IN LAY-IN	8.0 EA	
359 1051 000	PIPE HANGER 4IN LAY-IN	12.0 EA	
359 1053 000	PIPE HANGER 2.0IN LAY-IN	0.0 EA	
359 1055 000	PIPE HANGER 4.0IN LAY-IN	0.0 EA	
464 0055 000	SETTING TOOL	0.0 EA	
464 0056 000	DRILL MASONARY	0.0 EA	
690 0017 000	PIPE JOINT COMPOUND	1.0 EA	

Table 7-87. XMTR-Q, CD280P4/CD400P4 - 994 9651 004

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS (z)*
378 0196 000	IOT AND CIRCUIT ASSEMBLY 70KW	0.0 EA	ORDER QTY 4 FOR CD280P4 OR DROP SHIPMENTS. EEV
378 0198 000	IOT AND CIRCUIT ASSEMBLY 110KW	0.0 EA	ORDER QTY 4 FOR CD400P4 OR DROP SHIPMENTS. EEV
378 0213 000	KLYSTRODE, CDK2750W3	0.0 EA	

WARNING: Disconnect primary power prior to servicing.

			ORDER QTY 4 FOR CD280P4 OR DROP SHIPMENTS. CPI
378 0214 000	KLYSTRODE, CDK2110W3	0.0 EA	ORDER QTY 4 FOR CD400P4 OR DROP SHIPMENTS. CPI
3913-466-56810	3DB COUPLER LO POWER BD5	0.0 EA	SELECT FOUR FOR 626-860 MHZ
3913-466-59680	*3DB COUPLER LO POWER BD4	0.0 EA	SELECT FOUR FOR 470-636 MHZ
432 0393 000	BLOWER REGENERATIVE 2.5HP	0.0 EA	CHOOSE 4 FOR HIGH ALT.
484 0441 000	BREAKAWAY/FILTER, 470-596 MHZ	0.0 EA	ORDER QTY 4 FOR CH 14-34
484 0442 000	BREAKAWAY/FILTER, 596-704 MHZ	0.0 EA	ORDER QTY 4 FOR CH 35-52
484 0443 000	BREAKAWAY/FILTER, 704-862 MHZ	0.0 EA	ORDER QTY 4 FOR CH 53-69
484 0461 000	FILTER, LOW PASS 700MHZ	0.0 EA	ORDER QTY 4 FOR CH 14 TO 43
484 0462 000	FILTER, LOW PASS 1000MHZ	0.0 EA	ORDER QTY 4 FOR CH 44 TO 78
618 0731 000	LINE, ADJ CONSTANT Z	3.0 EA	FOR CONTROL CABINET PH ADJ 1, PH ADJ 2, PH ADJ 3
620 2957 008	CIRCULATOR, UHF	0.0 EA	ORDER QTY 8 FOR FEED FWD CH 14-26
620 2957 009	CIRCULATOR, UHF	0.0 EA	ORDER QTY 8 FOR FEED FWD CH 27-44
620 2957 010	CIRCULATOR, UHF	0.0 EA	ORDER QTY 8 FOR FEED FWD CH 45-69
620 2957 011	CIRCULATOR, UHF	0.0 EA	ORDER QTY 8 FOR FEED FWD CH 70-77
620 2974 000	CIRCULATOR, 470-547 MHZ	0.0 EA	ORDER QTY 16 FOR SINGLE IPA, 32 FOR DUAL IPA, CH 14-26
620 2975 000	*CIRCULATOR, 537-636 MHZ	0.0 EA	ORDER 16 FOR SINGLE IPA, 32 FOR DUAL IPA, CH 27-40
620 2976 000	*CIRCULATOR, 626-740 MHZ	0.0 EA	ORDER 16 FOR SINGLE IPA, 32 FOR DUAL IPA, CH 41-57
620 2977 000	*CIRCULATOR, 730-860 MHZ	0.0 EA	ORDER 16 FOR SINGLE IPA, 32 FOR DUAL IPA, CH 58-77
917 2300 133	NAMEPLATE, XMTR FCC SERIAL	1.0 EA	
917 2506 112	CABLE, COAX, W65	1.0 EA	USED IN CONTROL CABINET PH ADJ 2
992 8813 001	*ASSY, MODE CONTROLLER	1.0 EA	
992 9821 001	CABINET, REAR, SIGMA+	4.0 EA	
992 9822 002	CABINET, FRONT, LINEAR, SIGMA+	4.0 EA	
992 9824 002	CABINET, CONTROL (CD1A)	1.0 EA	
992 9830 002	KIT, EEV FITTINGS	0.0 EA	ORDER 4 FOR EEV TUBES
992 9830 016	KIT, SINGLE IPA	0.0 EA	ORDER QTY 4 WHEN USED WITH EEV 70KW ALL CHANNELS, EEV 100KW CH 26 AND LOWER
992 9830 017	KIT, DUAL IPA	0.0 EA	ORDER QTY 4 WHEN USED WITH CPI ALL POWER & CHANNELS EEV 100KW CH 27 AND UP
992 9830 020	KIT, DUAL EXCITER	0.0 EA	ORDER QTY 1 FOR DUAL EXCITER
992 9830 021	KIT, SINGLE EXCITER	0.0 EA	ORDER QTY 1 FOR SINGLE EXCITER
992 9830 026	KIT, CPI ASSY	0.0 EA	ORDER 4 FOR CPI TUBES
992 9830 027	KIT, ASSY, EEV	0.0 EA	ORDER 4 FOR EEV TUBES
992 9830 030	KIT, CPI FITTINGS	0.0 EA	ORDER 4 FOR CPI TUBES
994 9785 001	EXCITER,CD-1A UHF OR VHF TUNED	0.0 EA	ORDER 1 FOR SINGLE EXCITER, ORDER 2 FOR DUAL EXCITERS, QUINCY WILL FOR-MAT TO CHANNEL

WARNING: Disconnect primary power prior to servicing.

Table 7-88. CONTACTOR DRIVER QSIG+ - 992 9363 002

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
839 8121 451	WIRING DIAGRAM CONTACTOR	0.0 EA	
843 5469 516	ASSY DWG PCB CONT DRVR SIGMA+	0.0 EA	
992 9363 000	CONTACTOR DRIVER PCB	1.0 EA	
2400 086 00016	FUSE 10A T 5X20 HRC CER	4.0 EA	F001:F002:F003:F004

Table 7-89. LED DISPLAY PCB ASSY - 992 9737 043

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
839 8121 851	SCHEM FUSE PROT/LED DISPLAY	0.0 EA	
843 5469 074	PCB LED DISPLAY	1.0 EA	
9336 774 30682	LED 3MM MV5774C RED	7.0 EA	H001:H002:H003:H004: H005:H006:H007
0722 206 09005	CBL RIBBON 16WAY GREY	1.30 FT	
3913 240 10015	HEADER 16 WAY LTCH STRGHT STD	1.0 EA	X006
3913 240 10004	SKT 16 WAY LTCH IDC STD P/FL	2.0 EA	

Table 7-90. ISO SUPPLY 3 ASSY - 992 9737 092

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
839 8121 926	SCHEM ISO SUPPLIES 3 (EEV)	1.0 EA	
992 9415 039	ISO SUPPLY 3 ASSY MECH KIT	1.0 EA	
992 9502 049	ISO SUPPLY 3 PCB ASSY	1.0 EA	0010
952 9190 380	CABLE ISOLATED SUPPLIES 3	1.0 EA	0015
9338 827 61682	RECTFR SKB60/04 or /08 (60Amp)	1.0 EA	050
2400 490 01564	HEATSINK 120 X 120 X 120MM BLK	1.0 EA	060
917 2506 048	STANDOFF	3.0 EA	070
2413 531 00179	TRANSFORMER 12VA 20V	1.0 EA	0080
2222 114 16333	CAP 33000U 25V ELECT	2.0 EA	0000 C203 C204
8213 268 82046	CAP 500N 4KV TO SPEC	1.0 EA	C202
4322 043 04281	CLIP CAP 51MM	2.0 EA	110
2113 256 02316	RES 150R 5% 6W W/W	1.0 EA	R215
380 0795 000	TRANSISTOR, POWER ESD	2.0 EA	V010:V011
380 0796 000	TRANSISTOR, POWER, ESD	4.0 EA	V014:V015:V033:V034
2422 487 89512	SIL-PAD TO-3 X 0.177mm	6.0 PK	
335 0288 000	BUSHING, INSULATING, TO-3	12.0 EA	
302 0292 000	SCR HEX HD 1/4-20 X 3/4 SST	5.0 EA	200
302 0106 000	SCR PAN PHIL 6-32 X 3/8 SST	31.0 EA	203
302 0109 000	SCR PAN PHIL 6-32 X 5/8 SST	3.0 EA	204
302 0110 000	SCR PAN PHIL 6-32 X 3/4 SST	2.0 EA	205
2522 178 15106	SCR PNPZ ST18-8 M5X12	2.0 EA	0230
2522 401 50013	NUT FULLHEX ST18-8 M6	3.0 EA	0310
314 0009 000	SPLIT LOCK WASHER 1/4 SST	13.0 EA	405
314 0005 000	SPLIT LOCK WASHER No;6 SST	40.0 EA	410
310 0009 000	WASHER PLAIN 1/4" SST	5.0 EA	415
310 0038 000	WASHER PLAIN No;6 SST	40.0 EA	420
2522 600 79147	WSH PLN A ST18-8 M6	9.0 EA	0425
2513 712 02006	WSH CRKL ST18-8 M5	2.0 EA	0430
2513 712 02007	WSH CRKL ST 18-8 M6	7.0 EA	0440
358 3006 000	STANDOFF 6-32x0.875" M/F ALUM	2.0 EA	0470
2413 015 00141	CLIP CABLE P NY M6.4	1.0 EA	0475
1312 501 29501	HEATSINK COMPOUND DC340	0.0 EA	USE AS REQUIRED
2513 712 02005	WSH CRKL ST 18-8 M4	2.0 EA	0530
2413 015 00144	CLIP CABLE P NY M9.5	1.0 EA	0540

917 2336 154	MODIDFIED CORE EC70	4.0 EA	555
358 2209 000	U BOLT FOR EC70 CORE	2.0 EA	560
358 3134 000	STUD, BRS 1/4-20x1-3/4	3.0 EA	
0813 026 98327	TRIM EDGE-PVC 5/16 X 3/8"	0.70 ME	
306 0007 000	NUT FULL 1/4-20 SST	5.0 EA	
306 0004 000	NUT FULL 6-32 SST	6.0 EA	
2422 016 05019	SADDLE FOR 7.9MM TY-RAP	3.0 EA	
302 0143 000	SCR PAN PHIL 10-32 X 1/2 SST	3.0 EA	
306 0006 000	NUT FULL 10-32 SST	3.0 EA	
314 0007 000	SPLIT LOCK WASHER No;10 SST	7.0 EA	
304 0045 000	NUT CAP, 10-32 BRS	6.0 EA	
304 0039 000	NUT CAP, 5/16-18 BRS	4.0 EA	
304 0038 000	NUT CAP 1/4-20 BRS	4.0 EA	
310 0041 000	WASHER PLAIN 5/16 SST	4.0 EA	
314 0010 000	SPLIT LOCK WASHER 5/16 SST	4.0 EA	
307 0012 000	NUT, DOME M6 ST ST 18-8 A2	2.0 BX	
310 0040 000	WASHER PLAIN No;10 SST	2.0 EA	
302 0303 000	SCR, 5/16-18 X 5/8 HEX	4.0 EA	
302 0054 000	SCR PAN PHIL 4-40 X 3/8 SST	6.0 EA	
2422 015 01003	SOLDERTAG M4 SNGL BR SN	6.0 EA	
310 0056 000	WASHER #4 NARROW	12.0 EA	
314 0003 000	SPLIT LOCK WASHER No;4 SST	12.0 EA	
302 0056 000	SCR, 4-40x1/2 PHIL PAN ST/ST	6.0 EA	
302 0290 000	SCR HEX HD 1/4-20 X 1/2 SST	3.0 EA	840
304 0009 000	NUT FULL 1/4-20 BRSS	7.0 EA	850
308 0056 000	WASHER PLAIN 1/4" BRSS	11.0 EA	860
4322 020 02060	SPACER CER 7.00 X 1.3MM *	12.0 EA	

Table 7-91. ISO SUPPLIES 3 (CPI) - 992 9737 105

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
992 9737 092	ISO SUPPLY 3 ASSY	1.0 EA	
542 1663 000	RES 0.15 OHM 50W 5% W/W	2.0 EA	
952 9190 744	KIT CBLS ISO SUPPLIES 3 (CPI)	1.0 EA	
302 0054 000	SCR PAN PHIL 4-40 X 3/8 SST	4.0 EA	
314 0003 000	SPLIT LOCK WASHER No;4 SST	4.0 EA	
310 0037 000	WASHER PLAIN No;4 SST	4.0 EA	
1312 501 29501	HEATSINK COMPOUND DC340	0.0 EA	AS REQUIRED

Table 7-92. ISO SUPPLY 3 PCB ASSY - 992 9502 049

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
839 8121 915	SCHEM ISO SUPPLIES 3 (CPI)	0.0 EA	
839 8121 926	SCHEM ISO SUPPLIES 3 (EEV)	0.0 EA	
843 5469 576	DWG ISO SUPPLY 3 PCB	1.0 EA	
843 5469 076	PCB ISO SUPPLY 3	1.0 EA	
4322 020 02060	SPACER CER 7.00 X 1.3MM *	60.0 EA	015
2413 490 01046	HEATSINK TV-5	2.0 EA	020
2422 016 05019	SADDLE FOR 7.9MM TY-RAP	2.0 EA	025
402 0201 000	HOLDER FUSE CLIP DUAL SIZE	2.0 EA	030
2422 015 05069	TIE CABLE 3.5 X 150 NYLON NAT	2.0 EA	035
2432 020 00048	SKT RF BNC PCB MGT 50R	1.0 EA	X011:
610 1235 000	HEADER, STRAIGHT 4 PIN	1.0 EA	X001:
610 1306 000	HDR, 18PIN 1ROW STRAIGHT	1.0 EA	X018

3913 935 00045	REG 79L15 -15V 0.1A TO92	1.0 EA	A001:
9335 613 10682	IC RC4558P-00	2.0 EA	A002:A110
3913 935 00007	REG 7812 +12V 1.5A TO-220	1.0 EA	A101:
9334 636 90742	IC LM7912CT	1.0 EA	A102:
382 1347 000	IC LP311N (DIL-8)	2.0 EA	0000 A103:A104:
506 0266 000	CAP 1U 20% 250V PP	2.0 EA	0000 C001:C002:
2000 101 06478	CAP 4U7 25V ELSOL RAD/WIRE	1.0 EA	C205
524 0364 000	CAP 470U 385V ELECT	1.0 EA	C003:
2000 003 08229	CAP 22U 63V ELEC AX 105deg	2.0 EA	C014:C015
524 0363 000	CAP 100U 385V ELECT	1.0 EA	C004:
2013 751 15198	CAP 47P +-1PF 350/400V MICA	1.0 EA	C018
506 0271 000	CAP 100N 10% 400V PETP 15MM	3.0 EA	C005:C009:C119
2000 301 03223	CAP 22N 10% 400V PETP 10MM	1.0 EA	C017
2012 310 03124	CAP 330N 10% 63V PSTR 0.2" P	1.0 EA	C006
2222 030 27109	CAP 10U 40V ELECT	1.0 EA	C127
2012 310 03162	CAP 1U0 10% 50V PSTR 0.2" P	6.0 EA	C008:C110;C111:C010: C011:C126
522 0602 000	CAP 3300U 25V ELECT PCB MGT	2.0 EA	C101:C102:
2012 310 00318	CAP 100N 10% 63V PSTR 0.2"	11.0 EA	C007:C012:C013: C114:C115:C116:C117: C118:C120:C129:C128
2012 310 03125	CAP 470N 10% 63V PSTR 0.2" P	1.0 EA	C016
2222 683 34151	CAP 150P 2% 100V N150 0.2"	3.0 EA	C123:C124:C125
3913 200 10052	CAP 100N -20+80 50V CER	3.0 EA	0000 C103:C104:C109:
2222 030 36109	CAP 10U 25V ELECT	2.0 EA	0000 C105:C106:
2013 017 01543	CAP 10U 20% 16V TANT	4.0 EA	0000 C107:C108:C121:C122
8213 268 75169	CAP 47N 3KV +-5% PAPER	1.0 EA	C201:
2422 086 01015	FUSE 500MA T 5X20 LBC IEC127-3	1.0 EA	F001:
9338 827 15682	OPTO/TX HFBR-1522	6.0 EA	0000 H001:H101;H102;H103: H104:H107
9332 897 10682	LED 5MM HLMP-3507 GRN	2.0 EA	0000 H105:H106:
2413 535 00708	CHOKE 100UH 0W33 BS9751-N001-B	1.0 EA	L001
2122 550 00035	RES VD 220V 0.8W 24MM DIA	2.0 EA	R042:R043
2113 256 02641	RES 0R47 5% 2W5 W/W	2.0 EA	0000 R001:R002:
2113 256 02255	RES 4R7 5% 2W5 W/W	3.0 EA	R023:R128:R129
2113 256 02399	RES 22R 5% 9W W/W	1.0 EA	R003:
2322 156 12701	RES 270R 1% 0W6 MTLFLM	1.0 EA	R007
2122 362 00154	POT 200R 10% LIN W5 TOP ADJ	1.0 EA	R217
560 0092 000	RES VD 14V RMS 100J 20MM DIA	4.0 EA	R124:R127:R134:R215
2113 256 02902	RES 3K9 5% 2W5 W/W	1.0 EA	R006
2113 256 01041	RES 20K 5% 6W W/W	1.0 EA	R044
2113 256 02336	RES 4K7 5% 6W W/W	2.0 EA	R004:R207:
638 0036 000	METER SHUNT, DIGITAL 200MV 20A	1.0 EA	R216
2322 156 11502	RES 1K5 1% 0W6 MTLFLM	1.0 EA	R130: AOT 1K5 FOR EEV TUBES 1K8 FOR CPI TUBES
2113 256 02161	RES 1K0 5% 12W W/W	1.0 EA	R045:R046
2322 156 13901	RES 390R 1% 0W6 MTLFLM	2.0 EA	R111:R115:
2322 156 11808	RES 1R8 1% 0W6 MTLFLM	1.0 EA	R047
2113 256 02335	RES 3K9 5% 6W W/W	1.0 EA	R005
2113 256 02262	RES 47R 5% 2W5 W/W	1.0 EA	R051
2322 156 18202	RES 8K2 1% 0W6 MTLFLM	1.0 EA	R136
2322 156 13001	RES 300R 1% 0W6 MTLFLM	1.0 EA	R137
2322 156 11002	RES 1K 1% 0W6 MTLFLM	5.0 EA	0000 R011:R025:R026:R050: R107
2322 156 19101	RES 910R 1% 0W6 MTLFLM	1.0 EA	R131
2113 111 22473	RES 47K 2% 2W0 MTLOX	1.0 EA	R009:
2322 156 13301	RES 330R 1% 0W6 MTLFLM	4.0 EA	R010:R027:R028:R041
2322 156 12002	RES 2K 1% 0W6 MTLFLM	2.0 EA	R012:R109:
2113 111 25133	RES 12K 2% 1W0 MTLOX	1.0 EA	R013

WARNING: Disconnect primary power prior to servicing.

2322 156 11003	RES 10K 1% 0W6 MTLFLM	8.0 EA	R029:R036:R037:R121: R122:R123:R110: R135
2322 156 12003	RES 20K 1% 0W6 MTLFLM	1.0 EA	R030
2113 111 25103	RES 10K 2% 1W0 MTLOX	1.0 EA	R015:
2122 362 00159	POT 10K 10% LIN W5 TOP ADJ	1.0 EA	R038:
2113 111 00265	RES 6K8 2% 1W0 MTLOX	1.0 EA	R014:
2113 256 02257	RES 10R 5% 2W5 W/W	4.0 EA	0000 R016:R017:R018:R019:
2113 256 02275	RES 4K7 5% 2W5 W/W	1.0 EA	R133
2322 156 11001	RES 100R 1% 0W6 MTLFLM	2.0 EA	0000 R022:R024:
2322 156 11009	RES 10R 1% 0W6 MTLFLM	4.0 EA	R101:R102:R125:R126
2322 156 16801	RES 680R 1% 0W6 MTLFLM	1.0 EA	R040:
2322 156 15603	RES 56K 1% 0W6 MTLFLM	1.0 EA	R031:
2322 156 14704	RES 470K 1% 0W6 MTLFLM	4.0 EA	0000 R032:R033:R034:R035:
2322 156 11005	RES 1M 1% 0W6 MTLFLM	1.0 EA	R039
2322 156 11004	RES 100K 1% 0W6 MTLFLM	1.0 EA	
2322 156 11004	RES 100K 1% 0W6 MTLFLM	1.0 EA	R213:
2322 156 11504	RES 150K 1% 0W6 MTLFLM	1.0 EA	R103:
2322 156 12203	RES 22K 1% 0W6 MTLFLM	1.0 EA	R104:
2322 156 13002	RES 3K 1% 0W6 MTLFLM	1.0 EA	R214
2322 156 14302	RES 4K3 1% 0W6 MTLFLM	1.0 EA	R105
2322 156 19109	RES 91R 1% 0W6 MTLFLM	3.0 EA	0000 R106:R108:R132
2322 156 12001	RES 200R 1% 0W6 MTLFLM	2.0 EA	0000 R112:R113:
2322 156 14701	RES 470R 1% 0W6 MTLFLM	2.0 EA	0000 R116:R117:
2322 156 16202	RES 6K2 1% 0W6 MTLFLM	1.0 EA	R201:
548 2343 000	RES 500K 1W3 1 1.9397E-320C70 SERIES	10.0 EA	0000
2322 241 13106	RES 10M 5% 0W25 MTLGLZ	2.0 EA	R118:R119
2122 362 00158	POT 5K0 10% LIN W5 TOP ADJ	2.0 EA	R049:R120
2322 156 17502	RES 7K5 1% 0W6 MTLFLM	1.0 EA	R114
9338 828 06682	RECTFR 1B08 (800V-1A)	1.0 EA	V002:
9338 828 28682	DIODE 1.5KE200A TRANS O/VOLT	4.0 EA	V038:V039:V040:V041
380 0746 000	TRANS MPSA92	4.0 EA	0000 V003:V004:V009:V042
384 0789 000	TRANSZORB SA5.0 5V	2.0 EA	V036:V119
9330 473 10112	DIODE 1N916	14.0 EA	V005:V006: V020:V021: V022:V023:V025:V206: V110:V111 V112:V113:V114:V115
380 0747 000	TRANS MPSA42	4.0 EA	0000 V013:V017:V018:V019:
386 0459 000	DIODE BZW50-150	2.0 EA	0000 V024:V027
9338 820 00682	RECTFR 1B01 (100V 1Amp)	1.0 EA	V101:
9331 176 70112	DIODE BZX79C3V3	2.0 EA	V106:V116
9331 177 70112	DIODE BZX79C8V2	1.0 EA	0000 V102
9331 178 10112	DIODE BZX79C12	1.0 EA	V105
9330 791 70702	TRANS 2N3906 (TO-92)	1.0 EA	V103:
9336 508 70682	TRANS BS170 (TO-92)	1.0 EA	V026
9331 177 20112	DIODE BZX79C5V1	2.0 EA	0000 V104:V204:
384 0793 000	TRANSZORB SA15 15V	3.0 EA	V031:V108:V109
9330 745 40702	TRANS 2N3904 (TO-92)	2.0 EA	V107:V117
384 0020 000	DIODE 1N4004	5.0 EA	V028:V029:V030:V032 V035
9331 176 80112	DIODE BZX79C3V6	1.0 EA	V205:
384 0268 000	RECT 7.5KV PIV	2.0 EA	0000
384 0268 000	RECT 7.5KV PIV	2.0 EA	V202:V203:
2413 015 14086	TAB 6.3mm Vertical PCB MTG	23.0 EA	0000 X007:X008:X012:X013: X4/1:X4/2:X4/3; X006:X005:X010:X009: X002:X003:X015:X016: X017
2422 015 12168	TERM INSULUG M5 RED	2.0 EA	120
2422 015 12808	TERM PUSH-ON 6.3 x 0.5MM RED	4.0 EA	130

2522 178 15105	SCR PNPZ ST18-8 M5X10	2.0 EA	040
2522 178 15059	SCR PNPZ ST 18-8 M3X8	2.0 EA	080
2522 401 50012	NUT FULLHEX ST18-8 M5	2.0 EA	070
2522 401 50008	NUT FULLHEX ST18-8 M3	6.0 EA	090
2513 712 02006	WSH CRKL ST18-8 M5	2.0 EA	050
2513 712 02004	WSH CRKL ST 18-8 M3	6.0 EA	110
2522 600 79029	WSH PLN A ST 18-8 M5	2.0 EA	060
2522 600 79017	WSH PLN A ST18-8 M3	10.0 EA	100
2413 015 14168	TAG SOLDER PCB TAIL 2.5 X 0.9M	8.0 EA	101
917 2336 078	LABEL - ISOL.P/S. FUSE VALUES	1.0 EA	
3913 445 50110	HEADER 1 X 2	1.0 EA	LK01
2422 015 12167	TERM INSULUG M4 RED	2.0 EA	180
2522 178 15064	SCR PNPZ ST18-8 M3X16	4.0 EA	190
3913 080 52250	SPCR RND THRU M3 X 6 BRASS NI	4.0 PK	200
0722 186 00033	CBL 1.5MM2 (30/0.25) WHT	0.40 ME	210

Table 7-93. METER MULTIPLIER PCB ASSY - 992 9087 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
817 2336 371	SCHEM METER MULTIPLIER PCB	0.0 EA	
3913 461 74900	PCB - METER MULTIPLIER	1.0 EA	001
4322 020 02060	SPACER CER 7.00 X 1.3MM *	24.0 EA	005
2422 015 01002	SOLDERTAG M3 SNGL BR SN	2.0 EA	006
2522 178 15062	SCR PNPZ ST18-8 M3X12	2.0 EA	007
2522 401 50008	NUT FULLHEX ST18-8 M3	4.0 EA	008
2522 600 79017	WSH PLN A ST18-8 M3	8.0 EA	009
2513 712 02004	WSH CRKL ST 18-8 M3	2.0 EA	010
2422 015 01005	SOLDERTAG M6 SNGL BR SN	2.0 EA	012
2522 032 26231	SCR HEX ST18-8 M6X20	2.0 EA	015
2522 401 50013	NUT FULLHEX ST18-8 M6	4.0 EA	020
2522 600 79147	WSH PLN A ST18-8 M6	8.0 EA	025
2513 712 02007	WSH CRKL ST 18-8 M6	2.0 EA	026
548 2339 000	RES 15M 1W3 1 1.9397E-320C70 SERIES	12.0 EA	0000 R001 R002 R003 R004 R005 R006 R007 R008 R009 R010
548 2339 000	RES 15M 1W3 1 1.9397E-320C70 SERIES	12.0 EA	R011 R012
2113 116 13007	RES 25K 1% 0W5 MTLFLM	1.0 EA	0000 R013

Table 7-94. 8-WAY DUMP LOAD ASSY - 992 9737 103

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
3913 468 13270	CABLE ASSY (570MM) STRAIGHT	4.0 EA	010
952 9190 382	CABLE ASSEMBLY 1200MM STRAIGHT	4.0 EA	
3913 461 45540	LABEL BERYLLIA WARNING 15 X 30	1.0 EA	420
3913 081 65300	LABEL 15MM HAZARD-TOXIC	1.0 EA	430
3913 465 53790	HEATSINK - DUMP LOAD	1.0 EA	020
3913 464 15880	SPACER DUMP LOAD	8.0 EA	030
3913 464 17450	SCREEN	8.0 EA	050
3913 461 77440	PCB DUMP LOAD	8.0 EA	060
3913 464 19480	CABLE SUPPORT	1.0 EA	090
2522 178 15059	SCR PNPZ ST 18-8 M3X8	16.0 EA	100
2522 178 15058	SCR PNPZ ST 18-8 M3X6	64.0 EA	110
2513 712 02004	WSH CRKL ST 18-8 M3	80.0 EA	300
2122 900 00171	RES 50R 5% 250W B/OXIDE (TERM	8.0 EA	400
2522 615 04005	WSH LOCK INT 18-8 M3	16.0 EA	095

WARNING: Disconnect primary power prior to servicing.

2522 178 15061	SCR PNPZ ST18-8 M3X10	16.0 EA	125
2522 187 02044	SCR CSKSL 18-8 M2.5X6	32.0 EA	120
2522 401 60064	NUT FULHEX ST18-8 M2.5	32.0 EA	210
2513 712 02003	WSH CRKL ST 18-8 M2.5	32.0 EA	310
2422 015 05024	TIE CABLE 2.5 X 100 NYLON NAT	8.0 EA	

Table 7-95. THYRATRON INTERFACE PCB - 992 8748 002

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
839 8121 745	SCHEM CROWBAR ASSEMBLY	0.0 EA	
843 5469 052	PCB THYRATRON INTERFACE	1.0 EA	
506 0268 000	CAP 100N 5% 1600V PPS	1.0 EA	CAP 100N 5% 1600V PP C001
516 0985 000	CAP 100P 20% 3KV X5F CER	1.0 EA	CAP 100P 20% 3KV X5F C002
472 1731 000	XFMR CURRENT 20 TURN CT2 TOR	1.0 EA	0020 CT2
2422 086 01136	FUSE 6A3 T 5X20 LBC IEC127-3	1.0 EA	F001
2113 256 02147	RES 330R 5% 12W W/W	1.0 EA	RES 300R 5% 12W W/W R002
402 0201 000	HOLDER FUSE CLIP DUAL SIZE	2.0 EA	0045
2413 015 14086	TAB 6.3mm Vertical PCB MTG	3.0 EA	0050 X004:X005:X006
2422 015 01005	SOLDERTAG M6 SNGL BR SN	3.0 EA	055
300 1653 000	SCR 1/4-20 X 1-1/4 BRASS PHIL	3.0 EA	060
308 0009 000	WASHER PLAIN 1/4" BRSS	18.0 EA	065
2513 712 02007	WSH CRKL ST 18-8 M6	9.0 EA	070
304 0009 000	NUT FULL 1/4-20 BRSS	8.0 EA	075
4322 020 02060	SPACER CER 7.00 X 1.3MM *	2.0 EA	080
9338 827 27682	DIODE BAT48 (DO-35)	2.0 EA	V001:V002
2000 010 04222	CAP 2200U 25V ELEC RAD PCB	3.0 EA	C005:C006:C007
2413 015 14085	TAB 2.8MM PCB MTG	4.0 EA	X007:X008 CT2/1:CT2/2
9338 820 00682	RECTFR 1B01 (100V 1Amp)	1.0 EA	VC03
2322 156 14708	RES 4R7 1% 0W6 MTLFLM	1.0 EA	R004
2322 156 14302	RES 4K3 1% 0W6 MTLFLM	1.0 EA	R005
2122 362 00153	POT 100R 10% LIN W5 TOP ADJ	1.0 EA	R006
917 2462 071	COIL 100UH	1.0 EA	L002
504 0532 000	CAP 2200PF 20% 5KV	1.0 EA	C003
9330 619 30752	DIODE 1N4003	1.0 EA	V004
384 0789 000	TRANSZORB SA5.0 5V	1.0 EA	V005
9338 827 15682	OPTO/TX HFBR-1522	1.0 EA	H101
2322 156 11001	RES 100R 1% 0W6 MTLFLM	1.0 EA	R042

Table 7-96. IOT FDU2 PCB ASSY - 992 8815 002

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
843 5469 551	ASSY DWG PCB FDU 2	0.0 EA	
839 8121 744	SCHEM. IOT FDU2 PCB ASSY	1.0 EA	
943 5469 051	PCB FLOATING DECK 2	1.0 EA	0010
382 0882 000	REG 78L05 +5V 0.1A TO-92	1.0 EA	A003
382 1360 000	IC ICL7667CPA	1.0 EA	A002
524 0372 000	CAP 220U 200V ELECT	2.0 EA	C001:C002
506 0269 000	CAP 100N 10% 100V PETP 10MM	2.0 EA	0000 C003 C006
506 0271 000	CAP 100N 10% 400V PETP 15MM	1.0 EA	C005
2012 310 03165	CAP 100N 20% 1KV	1.0 EA	C011
2013 017 01587	CAP 10U 20% 35V TANT	1.0 EA	C017
506 0272 000	CAP 2U2 10% 100V PETP 22.5MM	1.0 EA	C007
506 0270 000	CAP 1U 10% 400V PETP 27.5MM	1.0 EA	C010
2012 310 00318	CAP 100N 10% 63V PSTR 0.2"	4.0 EA	C012:C013:C014:C018

382 1365 000	OPTO/RX HFBR-2532	1.0 EA	H001
382 1366 000	OPTO/TX HFBR-1532	1.0 EA	H002
9337 437 90682	LED 3MM MV5474C GRN	2.0 EA	H003:H004
2113 256 02169	RES 2K2 5% 12W W/W	1.0 EA	R003
2113 256 02174	RES 3K3 5% 12W W/W	2.0 EA	R026:R027
2113 256 02294	RES 82R 5% 2W5 W/W	1.0 EA	R004
2113 256 02187	RES 10K 5% 12W W/W	1.0 EA	R005
2113 256 02264	RES 100R 5% 2W5 W/W	1.0 EA	R006
2322 156 11005	RES 1M 1% 0W6 MTLFLM	2.0 EA	R008:R029
2113 256 02626	RES 10K 5% 2W5 W/W	4.0 EA	R009:R019:R021:R028
2322 156 11003	RES 10K 1% 0W6 MTLFLM	2.0 EA	R010:R023
2113 256 02266	RES 220R 5% 2W5 W/W	1.0 EA	R024
2113 256 02275	RES 4K7 5% 2W5 W/W	1.0 EA	R013
2322 156 11009	RES 10R 1% 0W6 MTLFLM	1.0 EA	R014
2322 156 11004	RES 100K 1% 0W6 MTLFLM	2.0 EA	R001:R002
2322 156 12201	RES 220R 1% 0W6 MTLFLM	2.0 EA	R020:R022
2113 256 01018	RES 8R2 5% 6W W/W	1.0 EA	R016
2113 256 02336	RES 4K7 5% 6W W/W	1.0 EA	R017
2113 256 02152	RES 470R 5% 12W W/W	1.0 EA	R018
2322 156 13902	RES 3K9 1% 0W6 MTLFLM	1.0 EA	R025
3913 469 06640	PULSE TRANSFORMER 1:4	1.0 EA	T003
384 0889 000	RECTFR 2KBP08	1.0 EA	V001
9336 705 40682	DIODE BZX85-C15	1.0 EA	V004
9330 635 30112	DIODE 1N4001	2.0 EA	V003:V018
380 0753 000	TRANS IRF450 (TO-3)	1.0 EA	V005
9333 636 30112	DIODE BYW56 SOD-57	2.0 EA	V006:V007
384 0888 000	DIODE BYW96E (SOD-64)	1.0 EA	V008
382 1362 000	IC SFH610-A-2	1.0 EA	V011
386 0469 000	ZENER, BZX85C30 30V 1.3W ESD	1.0 EA	V021
9336 706 00682	DIODE BZX85-C18	1.0 EA	V002
9332 848 30702	DIODE 1N5352B	1.0 EA	V009
9334 982 50113	DIODE 1N4007G	1.0 EA	V012
386 0459 000	DIODE BZW50-150	2.0 EA	V019:V022
9331 976 10112	TRANS BC547	2.0 EA	V014:V020
9331 177 70112	DIODE BZX79C8V2	2.0 EA	V010:V017
386 0440 000	DIODE 1N5339B	1.0 EA	V013
386 0401 000	DIODE 1N5347B	1.0 EA	V016
386 0342 000	DIODE 1N5333	2.0 EA	V015:V023
2413 015 00864	TERM SL4-V	1.0 EA	X001
2413 015 00885	TERM SL2-V	1.0 EA	X002
2413 015 00874	TERM SL3-V	1.0 EA	X003
4322 020 02060	SPACER CER 7.00 X 1.3MM *	30.0 EA	0255
2413 015 14168	TAG SOLDER PCB TAIL 2.5 X 0.9M	9.0 EA	TP01:TP02:TP03:TP04: TP05:TP06:X4: TP07
3913 445 50120	HEADER 1 X 3	1.0 EA	LINK1
2422 549 26016	SKT 2 WAY 2.54MM PITCH	1.0 EA	
302 0106 000	SCR PAN PHIL 6-32 X 3/8 SST	2.0 EA	
306 0004 000	NUT FULL 6-32 SST	2.0 EA	
310 0038 000	WASHER PLAIN No;6 SST	2.0 EA	
314 0005 000	SPLIT LOCK WASHER No;6 SST	2.0 EA	
2422 015 01003	SOLDERTAG M4 SNGL BR SN	1.0 EA	

Table 7-97. IOT2 INTERFACE PCB - 992 9384 001

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
817 2336 190	SCHEM IOT2 INTERFACE PCB	0.0 EA	
843 5469 520	ASSY DWG IOT2 INTERFACE	0.0 EA	
843 5469 020	PCB IOT2 INTERFACE	1.0 EA	0010
3913 240 00017	SKT 9 WAY D TYP PCB MTG	1.0 EA	0000 X001
3913 240 00021	SKT 37WAY D TYP PCB MTG	1.0 EA	X002
3913 240 00013	PLUG 15WAY D TYP PCB MTG	4.0 EA	0000 X003:X004:X008:X030
3913 240 00018	SKT 15WAY D TYP PCB MTG	1.0 EA	X029
3913 240 00019	SKT 25WAY D TYP PCB MTG	1.0 EA	X007
3913 240 00015	PLUG 37WAY D TYP PCB MTG	4.0 EA	X005:X006:X009:X032
2413 015 14086	TAB 6.3mm Vertical PCB MTG	2.0 EA	X035:X036
3913 080 52250	SPCR RND THRU M3 X 6 BRASS NI	24.0 PK	080
2413 040 00809	JACKSOCKET D TYP (PAIR)	12.0 EA	
2432 020 00048	SKT RF BNC PCB MGT 50R	1.0 EA	X025
2413 015 00864	TERM SL4-V	1.0 EA	X026
2413 015 00867	TERM SL10-V	2.0 EA	0000 X027:X028
2413 015 00893	TERM SL15-V	2.0 EA	125 X023:X037
2400 025 00013	HEADER 40 WAY LTCH STRGHT L/PF	3.0 EA	0000 X010:X011:X012:
2400 025 00008	HEADER 16 WAY LTCH STRGHT L/PF	1.0 EA	X053
2413 015 00863	TERM BL10	2.0 EA	X027:X028

Table 7-98. 40W AMP ASSY SIGMA++ - 992 9737 102

HARRIS P/N	DESCRIPTION	QTY/UM	REF. SYMBOLS/EXPLANATIONS
992 9415 037	40W AMP ASSY SIG MECH KIT	1.0 EA	
839 8121 923	SCHEM 40WATT AMP ASSY	0.0 EA	
992 9502 055	40W AMP PCB ASSY	1.0 EA	10
3913 461 45560	LABEL BERYLLIA WARNING 25 X 50	1.0 EA	12
3913 081 65320	LABEL 25MM HAZARD-TOXIC	1.0 EA	15
952 9215 192	HEATSINK, 40W AMP	1.0 EA	30
430 0250 000	FAN GUARD FOR W2E143 FAN	1.0 EA	70
2413 015 06312	GROMMET PVC 9.5X3.2X 7.9	2.0 EA	90
610 1247 000	MALE CONNECTOR, 4C	1.0 EA	X003
2100 265 20228	RES 2R2 5% 25W W/W ALUM CASE	2.0 EA	R025:R065
2100 265 10398	RES 3R9 5% 15W W/W ALUM CASE	2.0 EA	R016:R056
952 9190 742	40W AMP KIT OF CABLES	1.0 EA	150
430 0233 000	FAN AXIAL 48V 235CFM	1.0 EA	160
992 9095 001	CA5800 AMPLIFIER PCB ASSY	1.0 EA	180
336 1137 000	PIN SPRING 1/8 X 3/4" BER CU	2.0 EA	220
2413 015 01017	TERM INSUL DBLE M3 NUT	1.0 EA	230
0300 062 00002	FINGER CNCT STRP 8.6x1.6mm S/A	0.180 EA	240
2522 178 15059	SCR PNPZ ST 18-8 M3X8	15.0 EA	260
2522 177 04039	SCR PNSL 18-8 M2.5X8	8.0 EA	290
302 0052 000	SCR PAN PHIL 4-40 X 1/4 SST	4.0 EA	300
302 0106 000	SCR PAN PHIL 6-32 X 3/8 SST	40.0 EA	310
302 0108 000	SCR PAN PHIL 6-32 X 1/2 SST	4.0 EA	320
2513 712 02002	WSH CRKL ST 18-8 M2	4.0 EA	340
2513 712 02003	WSH CRKL ST 18-8 M2.5	8.0 EA	350
2513 712 02004	WSH CRKL ST 18-8 M3	14.0 EA	360
314 0005 000	SPLIT LOCK WASHER No;6 SST	40.0 EA	380
2522 600 79017	WSH PLN A ST18-8 M3	14.0 EA	400
310 0038 000	WASHER PLAIN No;6 SST	40.0 EA	420
9390 238 60112	WASHER 56326 (TO-126) LOAD	8.0 EA	450

WARNING: Disconnect primary power prior to servicing.

2400 490 01565	SIL-PAD TO-126 X 0.177mm	8.0 EA	460
9390 289 10112	BUSH 56387B (TO-126) INSUL	8.0 EA	470
2522 006 01003	SCR SKT CAP 18-8 M3X8	8.0 EA	490
302 0110 000	SCR PAN PHIL 6-32 X 3/4 SST	2.0 EA	510
9338 824 60682	IC CA5800C	3.0 EA	A002:A002:A003
9338 824 40682	TRANS TPV695A	2.0 EA	V001:V007
9338 824 50682	TRANS TPV7025	2.0 EA	V002:V008
9330 912 30112	TRANS BD140	4.0 EA	V004:V006:V010:V012
9330 912 20112	TRANS BD139	4.0 EA	V003:V005:V009:V011
3913 935 00007	REG 7812 +12V 1.5A TO-220	1.0 EA	A001
1312 501 29501	HEATSINK COMPOUND DC340	0.0 EA	USE AS REQUIRED
550 1094 000	POT 2K5 +-10% 1W CERMET	1.0 EA	R002
3913 081 65220	LABEL 25MM NON-IONIZING RADIAT	1.0 EA	650
302 0285 000	SCR PAN PHIL 8-32 X 1/2 SST	2.0 EA	660
310 0039 000	WASHER PLAIN No;8 SST	4.0 EA	670
314 0006 000	SPLIT LOCK WASHER No;8 SST	4.0 EA	680
306 0005 000	NUT FULL 8-32 SST	2.0 EA	690
302 0012 000	SCR, 2-56x1/4	4.0 EA	700
314 0003 000	SPLIT LOCK WASHER No;4 SST	4.0 EA	710
2522 401 60008	NUT FULLHEX ST18-8 M3	2.0 EA	720
3913 464 17180	M/F PILLAR	4.0 EA	730
302 0132 000	SCR PAN PHIL 8-32 X 5/8 SST	2.0 EA	750
2522 178 15064	SCR PNPZ ST18-8 M3X16	2.0 EA	760
2422 015 09508	PLUG HOLE 12.7x3.2MM NYL BLK	1.0 EA	

Table 7-99. MOV ASSY 380/415V (CONTACTOR) - 992 9502 017

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
843 5469 058	PCB-MOV (3 PHASE)	1.0 EA	
614 0914 000	TERM BLOCK SCREW TO TAG	1.0 EA	
560 0111 000	VARISTOR 275VAC 140J 369VDC	7.0 EA	R004:R005:R006:R007: R008:R009:R010
2522 178 15062	SCR PNPZ ST18-8 M3X12	4.0 EA	
2522 600 79017	WSH PLN A ST18-8 M3	8.0 EA	
2513 712 02004	WSH CRKL ST 18-8 M3	4.0 EA	
2522 401 50008	NUT FULLHEX ST18-8 M3	4.0 EA	

Table 7-100. FUSE PROTECTION PCB ASSY - 992 9502 056

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
839 8121 927	SCHEM FUSE PROT/LED DISPLAY	0.0 EA	
843 5469 593	ASSY DWG PCB FUSE PROTECT	0.0 EA	
843 5469 093	PCB, FUSE PROTECTION (15A)	1.0 EA	
9334 907 80682	IC ULN2803A	1.0 EA	A001
382 1070 000	OPTO COUPLER ILQ-1	1.0 EA	A002
3913 935 12028	IC 74HC32 4X 2 I/P OR (DIL-14	1.0 EA	A003
2012 310 00312	CAP 10N 20% 100V PSTR 0.2" P	3.0 EA	C001:C002:C003
2012 310 00318	CAP 100N 10% 63V PSTR 0.2"	1.0 EA	C006
2000 301 01105	CAP 1U 10% 100V PETP 15MM	2.0 EA	C004:C005
2413 086 01013	FUSE 5A T 6.3X32	2.0 EA	F002:F003
2400 086 00002	FUSE 15A F 6.3X32 CERAMIC	1.0 EA	F001
9338 827 16682	OPTO/RX HFBR-2522	2.0 EA	H008:H009
2422 025 02884	HEADER 3 WAY 0.1" PITCH	3.0 EA	LK01:LK02:LK03
2422 549 26016	SKT 2 WAY 2.54MM PITCH	3.0 EA	LK01:LK02:LK03
2322 156 16801	RES 680R 1% 0W6 MTLFLM	6.0 EA	R002:R003:R005:R006: R008:R009

WARNING: Disconnect primary power prior to servicing.

2322 156 11009	RES 10R 1% 0W6 MTLFLM	1.0 EA	R28
2322 156 13301	RES 330R 1% 0W6 MTLFLM	7.0 EA	R010:R011:R012:R013: R018:R019:R020
2322 156 11002	RES 1K 1% 0W6 MTLFLM	2.0 EA	R014:R016
2322 156 12202	RES 2K2 1% 0W6 MTLFLM	2.0 EA	R015:R017
2322 156 11003	RES 10K 1% 0W6 MTLFLM	1.0 EA	R029
2322 156 14702	RES 4K7 1% 0W6 MTLFLM	5.0 EA	R021:R022:R023:R026: R027
2322 156 13001	RES 300R 1% 0W6 MTLFLM	2.0 EA	R024:R025
2113 256 02299	RES 1K2 5% 2W5 W/W	3.0 EA	R001:R004:R007
9330 619 30752	DIODE 1N4003	3.0 EA	V004:V005:V006
9336 247 60112	DIODE BAT85	3.0 EA	V001:V002:V003
9336 508 70682	TRANS BS170 (TO-92)	2.0 EA	V007:V008
2422 015 01005	SOLDERTAG M6 SNGL BR SN	2.0 EA	0V IN:+32V IN USE 14SWG TCW TO CONNECT
610 1306 000	HDR, 18PIN 1ROW STRAIGHT	1.0 EA	X002
3913 240 10015	HEADER 16 WAY LTCH STRGHT STD	1.0 EA	
3913 240 10015	HEADER 16 WAY LTCH STRGHT STD	1.0 EA	X004
402 0129 000	CLIP, 1/4 DIA FUSE	6.0 EA	
610 1236 000	HEADER, STRAIGHT 8 PIN	1.0 EA	X003
2522 178 15135	SCR PNPZ ST18-8 M6X25	2.0 EA	
2522 600 79147	WSH PLN A ST18-8 M6	8.0 EA	
2513 712 02007	WSH CRKL ST 18-8 M6	4.0 EA	
2522 401 50013	NUT FULLHEX ST18-8 M6	4.0 EA	
4322 020 02060	SPACER CER 7.00 X 1.3MM *	6.0 EA	

Table 7-101. SWITCHED METER PCB ASSY - 992 9502 048

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
3913 461 78160	PCB COLLECTOR BODY FOCUS MONIT	1.0 EA	
2422 025 02795	HEADER 4 WAY 0.1" PITCH	1.0 EA	X002
2422 025 02931	HEADER 2 WAY 0.1" PITCH	1.0 EA	X003
2422 021 98412	HEADER 10 WAY 0.1" PITCH	1.0 EA	X001
3913 465 54210	MODIFIED SWITCH	1.0 EA	

Table 7-102. PSU DISTRIBUTION PCB ASSY - 992 8737 003

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
843 5469 073	PCB PSU DISTRIBUTION	1.0 EA	
614 0833 000	TERM STRIP 4 WAY PCB 5mm PITCH	3.0 EA	0000 X001 X003 X004
2400 015 00068	TERM BLOCK 6 WAY PCB 5mm Pin	2.0 EA	0000 X002 X005
9336 508 80682	TRANS BS250 (TO-92)	2.0 EA	V001:V002
9336 774 30682	LED 3MM MV5774C RED	2.0 EA	H001:H002
2012 310 00318	CAP 100N 10% 63V PSTR 0.2"	2.0 EA	C001:C002
2322 156 13301	RES 330R 1% 0W6 MTLFLM	2.0 EA	R001:R003
2322 156 11003	RES 10K 1% 0W6 MTLFLM	2.0 EA	R002::R004
2422 086 01021	FUSE 1A T 5X20 LBC IEC127-3	1.0 EA	F002
2422 086 01133	FUSE 3A15 T 5X20 LBC IEC127-3	1.0 EA	F001
402 0201 000	HOLDER FUSE CLIP DUAL SIZE	4.0 EA	

Table 7-103. DIGITAL & ANALOGUE PCB ASSY - 992 8739 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
992 8739 002	DIGITAL & ANALOG I/FACE	1.0 EA	
2322 156 11003	RES 10K 1% 0W6 MTLFLM	1.0 EA	R43
9336 247 60112	DIODE BAT85	2.0 EA	V005:V008

Table 7-104. DIGITAL & ANALOG I/FACE - 992 8739 002

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
839 8121 151	WIRING DIAG ANALOG &	0.0 EA	
3913 461 78140	PCB DIGITAL & ANALOGUE I/F	1.0 EA	010
9333 297 90682	OPTO COUPLER ILQ-74	6.0 EA	0000 A001:A039:A040:A041: A042:A043
382 0594 000	IC TL074ACN	6.0 EA	0000 A002:A003:A004:A045: A046:A047
3913 935 12051	IC 74HC04 HEX INV (DIL-14	4.0 EA	0000 A005:A032:A037:A038
3913 935 12013	IC 74HC08 2 I/P AND (DIL-14	4.0 EA	A006:A033:A048:A051:
382 0865 000	IC 74HC4538 MONSTBL (DIL-16	5.0 EA	A007:A008:A031:A044: A035
9338 827 28682	IC UCN5801A DIL-22	6.0 EA	0000 A009:A012:A014:A016: A020:A025
3913 935 12033	IC 74HC541 B/DRIVR (DIL-20	6.0 EA	0000 A010:A013:A015:A017: A021:A026
382 1081 000	IC 74HC126 QUAD BUF (DIL-14)	2.0 EA	0000 A011:A022
3913 935 35041	IC 4043 4X R/S LATCH DIL-16	4.0 EA	0000 A018:A019:A023:A024
9338 816 40682	IC ICL7673CPA	1.0 EA	A029
382 1348 000	IC ICL7665 (DIL-8)	1.0 EA	A030
3913 935 12012	IC 74HC02 2 I/P NOR (DIL-14	1.0 EA	A034
9335 327 60682	IC TL072CP (DIL-8)	1.0 EA	A050:
3913 935 12026	IC 74HC27 3 I/P NOR (DIL-14	1.0 EA	A036
3913 935 12096	IC 74HC10 3 I/P NAND (DIL-14	1.0 EA	A049:
2012 310 03125	CAP 470N 10% 63V PSTR 0.2" P	2.0 EA	C001:C002
2222 683 09398	CAP 3P9 0.25PF 100V NPO 0.2"	1.0 EA	C003
2222 683 10129	CAP 12P 2% 100V NPO 0.2"	1.0 EA	C004
2222 683 34229	CAP 22P 2% 100V N150 0.2"	3.0 EA	C005:C071:C073:
2222 630 19102	CAP 1N0 10% 100V MED-K 0.2"	3.0 EA	C006:C072:C074:
526 0351 000	CAP 6U8 50V 20%	1.0 EA	C078
2222 683 34479	CAP 47P 2% 100V N150 0.2"	1.0 EA	C007: FOR USE AT 45. 75MHZ
2222 683 34279	CAP 27P 2% 100V N150 0.2"	1.0 EA	C007: FOR USE AT 38. 9MHZ
2012 310 03162	CAP 1U0 10% 50V PSTR 0.2" P	8.0 EA	0000 C008:C009:C010:C014: C060:C061 C062:C063:
516 0760 000	CAP 100N 20% 50/63V X7R SIP8	2.0 EA	C080:C081
2012 310 00314	CAP 22N 20% 100V PSTR 0.2" P	1.0 EA	C011
2222 629 19103	CAP 10N -20+80 63V HI-K 0.2"	2.0 EA	C079:C083:
2012 310 00312	CAP 10N 20% 100V PSTR 0.2" P	26.0 EA	0000 C016:C017:C028:C029: C030:C031 C032:C033:C034:C035: C036:C037 C038:C039:C040:C041: C042:C043 C044:C045:C046:C047: C048:C050 C052:C054:
2222 123 17109	CAP 10U 40V ELSOL	1.0 EA	C025:
2013 017 01548	CAP 3U3 20% 16V TANT	1.0 EA	C013:
2020 021 90009	CAP 47U 25V ELECT	1.0 EA	C086
2012 310 00318	CAP 100N 10% 63V PSTR 0.2"	73.0 EA	

WARNING: Disconnect primary power prior to servicing.

			C020:C022:C024:C026: C027:C049 C051:C053:C055:C056: C057:C058 C059:C064:C066:C102: C103:C104 C105:C106:C107:C108: C109:C110 C111:C112:C113:C114: C115:C116 C117:C118:C119:C120: C121:C122 C123:C124:C125:C126: C129:C130 C131:C132:C133:C134: C135:C136 C137:C138:C144:C145: C146:C147
2012 310 00318	CAP 100N 10% 63V PSTR 0.2"	73.0 EA	C148:C202:C203:C204: C245:C246:C247: C069:C070: C149:C012: C150:C250:C075:C151: C068:C091:C065:C015
2222 630 19472	CAP 4N7 10% 100V MED-K 0.2"	3.0 EA	C067:C084:C085:
2000 101 03229	CAP 22U 10V ELSOL RAD/WIRE	1.0 EA	C018
2222 630 19332	CAP 3N3 10% 100V MED-K 0.2"	1.0 EA	0000 C077:
2000 101 04109	CAP 10U 16V ELSOL RAD/WIRE	4.0 EA	0000 C019:C021:C023:C082
2000 003 04221	CAP 220U 25V ELEC AX 105deg	1.0 EA	C076
2412 526 01041	BATTERY 3.6V POLARIZED	1.0 EA	G001
9338 827 16682	OPTO/RX HFBR-2522	6.0 EA	0000 H001:H012:H013:H014: H015:H016
9338 827 15682	OPTO/TX HFBR-1522	1.0 EA	H002
9337 437 90682	LED 3MM MV5474C GRN	9.0 EA	0000 H003:H004:H005:H006: H007:H008 H017:H018:H019
9336 774 30682	LED 3MM MV5774C RED	3.0 EA	0000 H009:H010:H011
2400 545 10026	BEAD FXD 3.5X1.2X3MM F14	1.0 EA	L001
3913 469 50410	COIL 0.58-1.04UH	1.0 EA	L002
2413 535 00708	CHOKE 100UH 0W33 BS9751-N001-B	6.0 EA	0000 L003:L004:L005:L006: L007:L008
2322 156 12203	RES 22K 1% 0W6 MTLFLM	7.0 EA	0000 R001:R002:R003:R004: R009:R020 R037
2322 156 11804	RES 180K 1% 0W6 MTLFLM	1.0 EA	R104:
2322 156 12201	RES 220R 1% 0W6 MTLFLM	1.0 EA	R005
2100 700 02101	RES 100R 2% 0.25W Size 1206	6.0 EA	0000 R006:R007:R017:R018: R028:R029
2322 156 17502	RES 7K5 1% 0W6 MTLFLM	1.0 EA	0000 R206:
2322 156 11001	RES 100R 1% 0W6 MTLFLM	1.0 EA	0000 R063:
2322 156 11503	RES 15K 1% 0W6 MTLFLM	6.0 EA	0000 R008:R019:R030:R031 R263:R267:
2322 156 15603	RES 56K 1% 0W6 MTLFLM	7.0 EA	R016:R027:R036:R192: R200:R211: R234:AOT
2322 156 12702	RES 2K7 1% 0W6 MTLFLM	2.0 EA	0000 R011:R022
2322 156 12704	RES 270K 1% 0W6 MTLFLM	1.0 EA	0000 R062:
2322 156 14702	RES 4K7 1% 0W6 MTLFLM	21.0 EA	0000 R012:R023:R093:R100: R114 R116:R117:R118: R123:R124 R139:R146:R147 R148:R152:R154:R159: R168:R169 R177:R205:
2322 156 11002	RES 1K 1% 0W6 MTLFLM	22.0 EA	0000 R013:R024:R040:R096:
2322 156 11002	RES 1K 1% 0W6 MTLFLM	22.0 EA	R097:R098 R099:R178:R251:R262: R274:R276: R223:R224:R228: R232:R233: R042:R053:R054:R252: R254:
2322 156 14704	RES 470K 1% 0W6 MTLFLM	14.0 EA	0000 R014:R025:R041:R173: R174:R179 R183:R193:R201:R212: R221:R245: R281:R288
2322 156 18202	RES 8K2 1% 0W6 MTLFLM	7.0 EA	0000 R015:R026:R035:R191: R199:R210: R244:
2322 156 13003	RES 30K 1% 0W6 MTLFLM	2.0 EA	R264:R268:
2322 156 12703	RES 27K 1% 0W6 MTLFLM	3.0 EA	R033:R265:R269:
2322 242 13106	RES 10M 5% 0W5 MTLGLZ	6.0 EA	R034:R266:R271:R272: R270:R273:
2322 156 11003	RES 10K 1% 0W6 MTLFLM	44.0 EA	

WARNING: Disconnect primary power prior to servicing.

			0000 R044:R045:R055: R059:R065 R067:R068:R071:R072: R075:R076 R079:R080:R083:R084: R087:R088 R095:R102:R120:R121: R156:R157 R175:R180:R190:R284: R287: R189:R196:R202: R285: R213:R218: R225:R229:R230: R231:R235 R248:R249:R250 R246:R247
2113 391 00577	POT 10K 10% LIN 0W5 CER M/T	14.0 EA	0000 R046:R047:R048:R049: R050:R051 R238:R239:R240:R241: R242:R243 R253:R255:
2322 156 14703	RES 47K 1% 0W6 MTLFLM	6.0 EA	0000 R056:R119:R155:R171: R172 R195:
2322 156 13304	RES 330K 1% 0W6 MTLFLM	1.0 EA	R058
2322 156 16202	RES 6K2 1% 0W6 MTLFLM	1.0 EA	0000 R032:
2322 156 11004	RES 100K 1% 0W6 MTLFLM	20.0 EA	0000 R060:R103:R107:R109 R176:R181:R184:R194: R203:R204 R214:R215:R219:R222: R226:R227 R280:R186:R187: R101:
2113 253 02515	RES 0R22 1% 3W W/W	2.0 EA	R278:R279
2322 156 12202	RES 2K2 1% 0W6 MTLFLM	9.0 EA	R064:R094:R275:R277: R010:R052: R021:R038:R283:
3913 017 00130	RES NWORK 10K X8 SIL9	12.0 EA	R069:R070:R073:R074: R077:R078 R081:R082:R085:R086: R089:R090
3913 017 00210	RES NWORK 47K X8 DIL16	1.0 EA	R289
2322 156 11202	RES 1K2 1% 0W6 MTLFLM	1.0 EA	R286:
2322 156 13301	RES 330R 1% 0W6 MTLFLM	1.0 EA	0000
2322 156 13301	RES 330R 1% 0W6 MTLFLM	1.0 EA	R092:
2322 156 12204	RES 220K 1% 0W6 MTLFLM	2.0 EA	0000 R182:R220:
2322 156 11005	RES 1M 1% 0W6 MTLFLM	1.0 EA	R105
2322 156 15103	RES 51K 1% OW6 MTLFLM	4.0 EA	R185:R188:R256:R257:
2322 156 18203	RES 82K 1% 0W6 MTLFLM	2.0 EA	R106:R207
2322 156 16801	RES 680R 1% 0W6 MTLFLM	8.0 EA	0000 R160:R161:R162:R163: R164:R165: R166:R167:
2322 156 18201	RES 820R 1% 0W6 MTLFLM	2.0 EA	0000 R110:R111:
2322 156 15601	RES 560R 1% 0W6 MTLFLM	1.0 EA	0000 R091:
2322 242 13335	RES 3M3 5% 0W5 MTLGLZ	1.0 EA	R113
2322 156 11802	RES 1K8 1% 0W6 MTLFLM	23.0 EA	0000 R112:R125:R126:R127: R128:R129 R130:R131:R132:R133: R136:R137 R138:R140:R143:R144: R145:R149 R150:R151:R153:R158: R039
2322 156 15102	RES 5K1 1% 0W6 MTLFLM	8.0 EA	R197:R198:R208:R209: R258:R259: R260:R261:
2322 156 11501	RES 150R 1% 0W6 MTLFLM	1.0 EA	R170
2322 156 11801	RES 180R 1% 0W6 MTLFLM	1.0 EA	R237:
2322 156 13903	RES 39K 1% 0W6 MTLFLM	1.0 EA	R282
2322 156 13902	RES 3K9 1% 0W6 MTLFLM	1.0 EA	R216:
2322 156 11302	RES 1K3 1% 0W6 MTLFLM	1.0 EA	R236
2322 156 16802	RES 6K8 1% 0W6 MTLFLM	1.0 EA	R217:
3913 050 52750	SWITCH P/B 2P MOM GOLD	1.0 EA	S001
9331 976 10112	TRANS BC547	4.0 EA	0000 V001:V015:V023:V024
9330 635 30112	DIODE 1N4001	1.0 EA	V002
9334 989 80702	TRANS MPSA06	2.0 EA	V003:V089:
9330 473 10112	DIODE 1N916	6.0 EA	V004:V080:V081:V084: V085:V086:
9336 247 60112	DIODE BAT85	46.0 EA	

			0000 V006:V007: V009:V010 V022:V033:V034:V035: V036 V037:V038:V039:V040: V041:V042 V043:V044:V045:V046: V047:V048 V049:V050:V051:V052: V053:V055 V056:V057:V058:V059: V060:V061 V062:V063:V064:V065: V066:V067 V078:V079:V068:V088: V082:V083:V032
9340 002 80682	DIODE HSMS-2820 (MARK-C0	3.0 EA	0000 V011:V012:V013:
9331 177 10112	DIODE BZX79C4V7	1.0 EA	V014
386 1448 000	TRANSZORB SA18 18V	2.0 EA	0000 V028:V029:
386 0447 000	TRANSZORB SA28 28V	8.0 EA	0000 V016:V017:V018:V019: V020:V021 V031:V054
9331 177 80112	DIODE BZX79C9V1	2.0 EA	V025:V026
384 0789 000	TRANSZORB SA5.0 5V	2.0 EA	V030:V087
9331 977 20112	TRANS BC557A	1.0 EA	V027
384 0793 000	TRANSZORB SA15 15V	9.0 EA	0000 V069:V070:V071:V072: V073:V074 V075:V076:V077
9331 178 50112	DIODE BZX79C18	1.0 EA	0000 V090:
2400 025 00013	HEADER 40 WAY LTCH STRGHT L/PF	5.0 EA	0000 X001:X006:X007:X008: X009
2422 025 02931	HEADER 2 WAY 0.1" PITCH	1.0 EA	X002
2400 031 00011	SKT RF SMC 50R PCB MTG STRGHT	4.0 EA	0000 X003:X004:X005:X029
2413 015 00867	TERM SL10-V	1.0 EA	X010
3913 445 50120	HEADER 1 X 3	7.0 EA	0000 X011:X012:X013:X027: X028:X030:X036
2413 015 02201	PIN TEST 1.3 X 1.02MM PCB	7.0 PK	0000 X014:X015:X016:X017: X018:X019
2413 015 02201	PIN TEST 1.3 X 1.02MM PCB	7.0 PK	X020
4322 020 02060	SPACER CER 7.00 X 1.3MM *	4.0 EA	
2422 025 02795	HEADER 4 WAY 0.1" PITCH	1.0 EA	X031
3913 445 50110	HEADER 1 X 2	2.0 EA	0000 X024:X025
2422 549 26016	SKT 2 WAY 2.54MM PITCH	9.0 EA	910
2432 490 00005	SKT DIL 22WAY x 0.4" FL/FRAME	6.0 EA	FOR:A009:A012:A014: A016:A020:A025
2432 490 00003	SKT DIL 16WAY x 0.3" FL/FRAME	7.0 EA	FOR:A001:A039:A040: A041:A042:A043:R289

Table 7-105. SIGMA+ LOGIC & CONT PCB ASSY - 992 9371 002

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
992 9371 001	SIGMA+ LOGIC & CONT PCB ASSY	1.0 EA	

Table 7-106. SIGMA+ LOGIC & CONT PCB ASSY - 992 9371 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
817 2336 172	SCHEM IOT2 LOGIC & CONTROL	0.0 EA	
843 5396 576	MOD INFO SIGMA+ CD LOGIC PCB	0.0 EA	
843 5469 517	ASSY DWG PCB LOGIC & CONTROL	0.0 EA	
843 5469 017	PCB LOGIC & CONTROL (IOT2)	1.0 EA	010
3913 935 12016	IC 74HC133 13I/P NAND (DIL-16	1.0 EA	A001
3913 935 12013	IC 74HC08 2 I/P AND (DIL-14	11.0 EA	0000 A002:A008:A020:A042: A063:A070:A100: A076:A085:A088:A092
382 0774 000	IC 74HC14 HEX SCHMIDT (DIL-14	2.0 EA	A096:A112
3913 935 12012	IC 74HC02 2 I/P NOR (DIL-14	1.0 EA	A003
382 0882 000	REG 78L05 +5V 0.1A TO-92	1.0 EA	A097
3913 935 12051	IC 74HC04 HEX INV (DIL-14	5.0 EA	0000 A004 A041 A071 A087
3913 935 12051	IC 74HC04 HEX INV (DIL-14	5.0 EA	A093
382 1070 000	OPTO COUPLER ILQ-1	4.0 EA	A098:A055:A056:A057
382 0773 000	IC 74HC11 3I/P & GATE (DIL-14	3.0 EA	0000 A005:A043:A090

WARNING: Disconnect primary power prior to servicing.

3913 935 12047	IC 74HC86 8X 2 I/P OR (DIL-14	1.0 EA	A101
3913 935 12018	IC 74HC161 B/CONNTR (DIL-16	16.0 EA	0000 A006 A007 A029 A030 A031 A037 A038 A039 A059 A060 A061 A066 A067 A068 A083 A084
3913 935 12096	IC 74HC10 3 I/P NAND (DIL-14	1.0 EA	A102
382 0865 000	IC 74HC4538 MONSTBL (DIL-16	5.0 EA	A009:A040:A080:A089: A091
9338 822 70682	IC X9C103P (DIL-8	1.0 EA	A103
3913 935 12094	IC 74HC688 CMPRTR (DIL-20	6.0 EA	0000 A010 A028 A036 A058 A065 A082
9335 004 40749	IC LM324N (DIL-14	1.0 EA	
9335 004 40749	IC LM324N (DIL-14	1.0 EA	A104
9338 827 28682	IC UCN5801A DIL-22	6.0 EA	0000 A011 A014 A016 A018 A024 A086
3913 935 12048	IC 74HC157 2 I/P MUX (DIL-16	1.0 EA	A106
3913 935 12033	IC 74HC541 B/DRIVR (DIL-20	5.0 EA	0000 A012 A015 A017 A019 A025
3913 935 12079	IC 74HC4053 MUX/DEMUX (DIL-14	1.0 EA	A108
382 1081 000	IC 74HC126 QUAD BUF (DIL-14)	5.0 EA	0000 A013:A023:A035:A048: A072
382 0594 000	IC TL074ACN	2.0 EA	A109:A113
3913 935 35041	IC 4043 4X R/S LATCH DIL-16	6.0 EA	0000 A021:AA22:A026:A027: A047:A081
3913 935 12035	IC 74HC74 2X D F/F (DIL-14	2.0 EA	A110:A111
3913 935 12011	IC 74HC00 2 I/P NAND (DIL-14	1.0 EA	A032
3913 935 12028	IC 74HC32 4X 2 I/P OR (DIL-14	4.0 EA	0000 A033:A064:A077:A099
382 0856 000	IC 74HC4078 NOR/OR (DIL-14)	3.0 EA	0000 A074 A075 A079
382 0793 000	IC 74HC147 10-4 ENCDR (DIL-16	1.0 EA	
382 0793 000	IC 74HC147 10-4 ENCDR (DIL-16	1.0 EA	A044
3913 935 12097	IC 74HC20 4 I/P NAND (DIL-14	1.0 EA	A045
3913 935 12032	IC 74HC540 B/DRIVR (DIL-20	1.0 EA	A046
382 1351 000	IC 74HC4066 SWTCH (DIL-14)	3.0 EA	0000 A050 A051 A052
3913 935 12116	IC 74HC4060 CNTR (DIL-16	2.0 EA	A073:A095:
382 0851 000	IC 74HC4040 COUNTER (DIL-16)	1.0 EA	A078
382 0782 000	IC 74HC75 B/STBL LTCH (DIL-16)	1.0 EA	A094
444 2987 000	CRYSTAL 32.7680MHZ	1.0 EA	B001
2012 310 00318	CAP 100N 10% 63V PSTR 0.2"	121.0 EA	C001:C007:C101:C102: C103 C104:C105:C106:C107: C108:C109 C110:C111:C112:C113: C114:C115 C116:C117:C118:C119: C120:C121 C122:C123:C124:C125: C126:C127 C128:C129:C130:C131: C132:C133 C135:C136:C137:C138: C139:C140 C141:C142:C143:C144: C145:C146 C147:C148:C150:C151: C152:C158 C159:C160:C161:C163: C164:C165 C166:C167:C168:C170: C171:C172 C173:C174:C175:C176: C177:C178 C179:C180:C181:C182: C183:C184
2012 310 00318	CAP 100N 10% 63V PSTR 0.2"	121.0 EA	C185:C186:C187:C188: C189:C190 C191:C192:C193: C194:C195: C028:C030:C038:C039: C040:C037 C045 C196:C197:C202:C205: C206:C207:C209:C210: C212:C214:C215:C216: C217:C218:C219:C225: C226:C227:C228:C229: C230:C231:C232:C233 C211:C235
516 0760 000	CAP 100N 20% 50/63V X7R SIP8	2.0 EA	C031:C032
2000 003 03102	CAP 1000U 16V ELEC AX 105deg	1.0 EA	C198
2012 310 03124	CAP 330N 10% 63V PSTR 0.2" P	1.0 EA	C199

2012 310 03162	CAP 1U0 10% 50V PSTR 0.2" P	3.0 EA	0000 C002:C004:C026:
2000 101 04478	CAP 4U7 16V ELSOL RAD/WIRE	1.0 EA	C213
2000 101 02479	CAP 47U 6V3 ELSOL RAD/WIRE	4.0 EA	0000 C003:C005:C006:C015
2013 017 01584	CAP 1U0 20% 35V TANT	4.0 EA	C220:C221:C222:C324
2013 017 01522	CAP 10U 20% 10V TANT	1.0 EA	C024:
2222 683 10109	CAP 10P 2% 100V NPO 0.2"	1.0 EA	C013
2222 809 07008	CAP 4P0 - 40P TRIM (40E)	1.0 EA	C014
2000 101 03229	CAP 22U 10V ELSOL RAD/WIRE	2.0 EA	0000 C20:C22:
2012 310 00312	CAP 10N 20% 100V PSTR 0.2" P	7.0 EA	0000 C021:C023:C025:C018:
2012 310 00312	CAP 10N 20% 100V PSTR 0.2" P	7.0 EA	C041:C042:C200
2000 003 04221	CAP 220U 25V ELEC AX 105deg	1.0 EA	C29:
2000 101 04109	CAP 10U 16V ELSOL RAD/WIRE	1.0 EA	0000 C19:
2222 630 19472	CAP 4N7 10% 100V MED-K 0.2"	7.0 EA	0000 C033:C034:C035:C036: C016:C027:C043:
384 0891 000	LED 10 SEG BARGRAPH.GRN 8.0mm	4.0 EA	360 H002 H003 H004 H005
9337 437 90682	LED 3MM MV5474C GRN	4.0 EA	0000 H001 H014 H015 H016
9335 467 80723	LED 10 SEG BARGRAPH.RED 8.0mm	3.0 EA	0000 H006 H007 H008
9336 966 20682	LED MV54124 GRN	11.0 EA	0000 H009:H010:H011:H012: H013:H018:H019:H020: H021:H022:H023
9335 110 70723	LED MV57124 RED	1.0 EA	H017
3913 017 00410	RES NWORK 100K X8 SIL9	1.0 EA	0000 R165:
2322 156 14702	RES 4K7 1% 0W6 MTLFLM	11.0 EA	R167:R168:R182:R191: R193:R237 R047:R048:R049:R050 R051
2322 156 17502	RES 7K5 1% 0W6 MTLFLM	2.0 EA	R245:R246
2322 156 12202	RES 2K2 1% 0W6 MTLFLM	12.0 EA	0000 R002:R026:R028:R034: R036:R043:R222:R248: R138:R142:R146:R150
2113 391 00577	POT 10K 10% LIN 0W5 CER M/T	4.0 EA	R183:R192:R196:R240
2322 156 11003	RES 10K 1% 0W6 MTLFLM	40.0 EA	0000 R003:R005:R011:R012: R014:R015:R017:R018 R020:R021:R023:R024 R029:R037:R046:R072 R073:R086:R091:R092 R093:R094:R154:R155 R159:R160:R169:R186: R187:R198:R199:R202: R204:R206:R209:R233: R234,R242,R247,R161
2322 156 13003	RES 30K 1% 0W6 MTLFLM	1.0 EA	R085
2322 156 13301	RES 330R 1% 0W6 MTLFLM	18.0 EA	0000 R004:R120:R121:R122: R123:R124:R125:R126: R127:R128:R129:R130: R131:R132:R134:R172: R173:R236
2322 156 18202	RES 8K2 1% 0W6 MTLFLM	1.0 EA	R207
2322 156 11801	RES 180R 1% 0W6 MTLFLM	26.0 EA	0000 R095:R096:R097:R098: R099:R100 R101:R102:R103:R104: R105:R106 R107:R108:R109:R110: R111:R112 R113:R114:R115:R116: R117:R118 R119:R133
2322 156 13902	RES 3K9 1% 0W6 MTLFLM	4.0 EA	R208:R213:R214:R215
2322 156 14704	RES 470K 1% 0W6 MTLFLM	8.0 EA	R006:R030:
2322 156 14704	RES 470K 1% 0W6 MTLFLM	8.0 EA	R157:R158:R184:R189: R195:R239
2322 156 16204	RES 620K 1% 0W6 MTLFLM	1.0 EA	0000 R039:FOR EEV TUBES
2113 253 02515	RES 0R22 1% 3W W/W	2.0 EA	R162:R163
2322 156 13304	RES 330K 1% 0W6 MTLFLM	1.0 EA	R007
2322 156 14703	RES 47K 1% 0W6 MTLFLM	4.0 EA	R166:R219:R220:R226
3913 017 00130	RES NWORK 10K X8 SIL9	14.0 EA	0000 R009:R010:R013:R016: R019:R022 R032:R033:R040:R041: R045 R082:R090:R025:
2322 156 12001	RES 200R 1% 0W6 MTLFLM	3.0 EA	R216:R223:R224
2322 156 11005	RES 1M 1% 0W6 MTLFLM	2.0 EA	0000 R148:R203 R039:FOR CPI TUBES

2322 241 13106	RES 10M 5% 0W25 MTLGLZ	1.0 EA	R084:
2322 156 11002	RES 1K 1% 0W6 MTLFLM	25.0 EA	0000 R001:R038:R042: R052:R053:R054:R055: R056:R156:R181: R185:R188:R190:R194: R197:R212:R218:R221: R225:R231:R235:R238: R241:R244: R211
2322 156 14701	RES 470R 1% 0W6 MTLFLM	4.0 EA	R227:R228:R229:R230
2322 156 18201	RES 820R 1% 0W6 MTLFLM	10.0 EA	0000 R057 R058
2322 156 18201	RES 820R 1% 0W6 MTLFLM	10.0 EA	R059 R060 R061 R062 R063 R064 R065 R066
2322 156 16804	RES 680K 1% 0W6 MTLFLM	2.0 EA	R027:R035
2322 156 11802	RES 1K8 1% 0W6 MTLFLM	5.0 EA	0000 R067 R068 R069 R070 R071
2322 156 11004	RES 100K 1% 0W6 MTLFLM	13.0 EA	0000 R006,R008,R031,R074 R136,R140,R144,R164, R200:R201:R210:R217 R243
2322 156 12203	RES 22K 1% 0W6 MTLFLM	6.0 EA	0000 R137:R141:R145:R149: R176:R205
2422 128 02074	SWITCH P/B SPDT 0.4A	1.0 EA	S001
604 1141 000	SWITCH P/B MEMBRANE	12.0 EA	0000 S002:S009:S010:S011: S012:S013:S014:S015: S016:S017:S018:S019
598 0450 000	CAP SPACING W/ 2 HOLES	12.0 EA	575
2413 127 00071	SWITCH DIL 8 POLE SPST	6.0 EA	0000 S003 S004 S005 S006 S007 S008
9336 247 60112	DIODE BAT85	24.0 EA	0000
9336 247 60112	DIODE BAT85	24.0 EA	V001:V002:V008:V009: V010:V011:V012:V015: V016:V017:V018:V024: V027:VO28:V029:V030: V031:V032:V033:V034 V036:V037:V038:V039
384 0020 000	DIODE 1N4004	1.0 EA	V025
384 0789 000	TRANSZORB SA5.0 5V	2.0 EA	V019:V020
9336 508 70682	TRANS BS170 (TO-92)	1.0 EA	V026
386 0447 000	TRANSZORB SA28 28V	5.0 EA	0000 V003 V004 V005 V006 V007
9334 989 80702	TRANS MPSA06	4.0 EA	V021:V022:V023:V035
3913 445 50120	HEADER 1 X 3	21.0 EA	0000 X001:X002:X003:X004: X008:X009 X010:X011:X012:X013: X014:X020 X021:X022:X023:X024: X025:X026 X027:X028:X039
2400 025 00008	HEADER 16 WAY LTCH STRGHT L/PF	1.0 EA	X029
2400 025 00013	HEADER 40 WAY LTCH STRGHT L/PF	3.0 EA	0000 X005:X006:X036
2413 015 00867	TERM SL10-V	1.0 EA	X007
3913 445 50110	HEADER 1 X 2	5.0 EA	0000 X015 X016 X017 X018
3913 445 50110	HEADER 1 X 2	5.0 EA	X019
2422 549 26016	SKT 2 WAY 2.54MM PITCH	27.0 EA	650
4322 020 02060	SPACER CER 7.00 X 1.3MM *	4.0 EA	660
2432 490 00003	SKT DIL 16WAY x 0.3" FL/FRAME	3.0 EA	FOR A055:A056:A057
2432 490 00005	SKT DIL 22WAY x 0.4" FL/FRAME	1.0 EA	FOR A086
2413 015 14085	TAB 2.8MM PCB MTG	8.0 EA	X030:X031:X032:X033: X034:X035:X037:X038
2413 015 14168	TAG SOLDER PCB TAIL 2.5 X 0.9M	6.0 EA	R234:R244:V039

Table 7-107. MOV PCB ASSY 198-250 VOLT - 992 8553 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
560 0111 000	VARISTOR 275VAC 140J 369VDC	12.0 EA	
610 1066 000	CONN, 0.25 FASTON PC MOUNT	3.0 EA	
839 7900 606	PWB, MOV-AC PROTECTOR	1.0 EA	
839 7900 614	SCHEM, MOV-AC PROTECTOR	0.0 EA	
999 2710 001	WIRE/TUBING LIST	0.0 EA	

Table 7-108. MARSHALLING PCB ASSEMBLY - 992 9367 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
84354690151	MARSHALLING PCB	1.0 EA	
2413 015 00889	TERM SL12-V	9.0 EA	X001:X002:X003:X004 X005:X006:X007:X008 X009
2012 310 00318	CAP 100N 10% 63V PSTR 0.2"	7.0 EA	C001:C002:C003:C004 C005:C006:C007
2413 535 00419	CHOKE 100UH 0W33 BS9751-N001-D	7.0 EA	L001:L002:L003:L004 L005:L006:L007
9334 982 00112	DIODE 1N4002G	10.0 EA	V001:V002:V003:V004 V005:V006:V007:V008 V009:V010
9330 473 10112	DIODE 1N916	1.0 EA	V011
2413 015 00881	TERM BL12	9.0 EA	X001:X002:X003:X004 X005:X006:X007:X008 X009
2400 131 00051	RELAY 5V.dc 2P C/O PCB MTG	1.0 EA	K001
3913 240 10012	HEADER 10 WAY LTCH STRGHT STD	1.0 EA	X010

Table 7-109. SYST INTERFACE CD MK2 PCB ASSY - 992 9502 067

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
839 8121 799	SCHEM SYSTEM INTERFACE (CD)	0.0 EA	
843 5469 096	PCB-SYSTEM INTERFACE (CD)	1.0 EA	010
2413 015 00861	TERM BL6	1.0 EA	X028
9334 907 80682	IC ULN2803A	10.0 EA	0000 A001:A002:A003:A004: A005:A014:A016:A020: A022:A028
382 0594 000	IC TL074ACN	5.0 EA	0000 A006:A007:A008:A009: A010
382 0856 000	IC 74HC4078 NOR/OR (DIL-14)	1.0 EA	A011
382 0813 000	IC 74HC240 OCTAL BUF (DIL-20)	5.0 EA	0000 A015:A021:A024:A025: A027
3913 935 12047	IC 74HC86 8X 2 I/P OR (DIL-14	1.0 EA	A030
3913 935 12028	IC 74HC32 4X 2 I/P OR (DIL-14	1.0 EA	A023
2012 310 00318	CAP 100N 10% 63V PSTR 0.2"	19.0 EA	0000 C001:C002:C004:C005: C008:C009:C010:C011: C014:C015:C032:C033: C040:C041:C044:C046: C047:C049:C050
2012 310 00325	CAP 1U0 20% 63V PSTR 0.2" P	5.0 EA	0000 C003:C006:C007:C012: C013
2222 630 19102	CAP 1N0 10% 100V MED-K 0.2"	5.0 EA	C016:C017:C020:C023: C024
2012 310 03125	CAP 470N 10% 63V PSTR 0.2" P	5.0 EA	C026:C027:C028:C029: C030
2222 683 34229	CAP 22P 2% 100V N150 0.2"	5.0 EA	C018:C019:C021:C022: C031
516 0760 000	CAP 100N 20% 50/63V X7R SIP8	5.0 EA	0000 C034:C035:C042:C043: C045
2322 156 11503	RES 15K 1% 0W6 MTLFLM	20.0 EA	0000 R001:R003:R012:R015: R031:R033:R034:R036: R053:R055:R057:R065: R062:R072:R078: R056:R063:R069:R074: R080: A.O.T.
2413 015 14168	TAG SOLDER PCB TAIL 2.5 X 0.9M	12.0 EA	
2322 156 11004	RES 100K 1% 0W6 MTLFLM	10.0 EA	0000 R002:R014:R030:R037: R052:R064:R068:R071: R077:R082
2322 156 14702	RES 4K7 1% 0W6 MTLFLM	15.0 EA	0000 R004:R007:R016:R020: R026:R029:R038:R041: R046:R051:R009:R013: R032:R035:R054
2322 156 11002	RES 1K 1% 0W6 MTLFLM	10.0 EA	0000 R005:R010:R017:R021: R024:R028:R039:R043: R048:R050
2322 156 18202	RES 8K2 1% 0W6 MTLFLM	5.0 EA	0000 R006:R019:R027:R040: R047
2322 156 14704	RES 470K 1% 0W6 MTLFLM	10.0 EA	0000 R008:R018:R025:R042: R049:R139:R141:R143: R145:R147
2113 391 00589	POT 1M 10% LIN 0W5 CER M/T	5.0 EA	0000 R140:R142:R144:R146: R148
3913 017 00270	RES NWORK 22K X8 SIL9	1.0 EA	R130

WARNING: Disconnect primary power prior to servicing.

2322 156 11003	RES 10K 1% 0W6 MTLFLM	10.0 EA	0000 R011:R022:R023:R044: R045:R137:R138: R070:R075:R081
2322 241 13105	RES 1M 5% 0W25 MTLGLZ	5.0 EA	0000 R058:R059:R060:R061: R076
2113 391 00577	POT 10K 10% LIN 0W5 CER M/T	10.0 EA	0000 R088:R089:R090:R091: R092:R093:R094:R095: R096:R097
2100 700 02101	RES 100R 2% 0.25W Size 1206	10.0 EA	0000 R102:R103:R104:R105: R106:R107:R108:R109: R110:R111
3913 017 00390	RES NWORK 22K X8 DIL16	5.0 EA	0000 R114:R115:R122:R123: R126
3913 017 00960	RES NWORK 1K0 X8 DIL16	1.0 EA	R128
3913 017 00180	RES NWORK 1K0 X8 SIL9	4.0 EA	R116:R117:R124:R125
3913 017 00130	RES NWORK 10K X8 SIL9	1.0 EA	0000 R127
3913 017 01100	RES NWORK 390R X8 SIL9	1.0 EA	R135
9336 247 60112	DIODE BAT85	10.0 EA	0000 V001:V002:V004:V005: V006:V007:V010:V011: V012:V013
9340 002 80682	DIODE HSMS-2820 (MARK-C0	5.0 EA	0000 V003:V008:V009:V014: V015
9330 473 10112	DIODE 1N916	15.0 EA	0000 V016:V017:V018:V019: V020:V021:V022:V023: V024:V025:V026:V027: V028:V029:V030
2413 015 00864	TERM SL4-V	1.0 EA	X002
3913 240 10015	HEADER 16 WAY LTCH STRGHT STD	1.0 EA	X003
3913 240 10021	HEADER 50 WAY LTCH STRGHT STD	1.0 EA	X004
3913 240 00015	PLUG 37WAY D TYP PCB MTG	3.0 EA	0000 X005:X006:X015
2413 015 00865	TERM SL6-V	1.0 EA	X028
2400 031 00029	SKT RF BNC PCB 50R 16mm High	5.0 EA	0000 X009:X010:X011:X012: X013
3913 240 00021	SKT 37WAY D TYP PCB MTG	1.0 EA	X007
3913 240 00013	PLUG 15WAY D TYP PCB MTG	4.0 EA	0000 X016:X017:X020:X021
3913 240 00012	PLUG 9 WAY D TYP PCB MTG	1.0 EA	X022
2422 549 26016	SKT 2 WAY 2.54MM PITCH	5.0 EA	X023:X024:X025:X030: X031 X032:X033
2413 040 00809	JACKSOCKET D TYP (PAIR)	11.0 EA	255
3913 080 52250	SPCR RND THRU M3 X 6 BRASS NI	22.0 PK	260
3913 445 50110	HEADER 1 X 2	7.0 EA	0265 X023:X024:X025:X030: X031 X032:X033
2432 490 00002	SKT DIL 14WAY x 0.3" FL/FRAME	1.0 EA	FOR A023
2432 490 00032	SKT DIL 20WAY x 0.3" FL/FRAME	1.0 EA	FOR A027
2432 490 00004	SKT DIL 18WAY x 0.3" FL/FRAME	4.0 EA	FOR A001:A002:A003 A004

Table 7-110. PSU DIST PCB/HEATSINK ASSY - 992 9834 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
839 8121 787	SCHEM EXC CUB DIST PCB	0.0 EA	
992 9502 050	CONT CAB PSU DIST PCB ASSY	1.0 EA	
382 1634 000	IC, LT1083CP-12 ESD	2.0 EA	A001:A008
382 1633 000	IC, LM333 ESD	2.0 EA	A002:A007
9338 818 20682	IC MC78T12CT	2.0 EA	A003:A005
3913 935 00001	REG 7805 +5V 1.5A TO-220	2.0 EA	A004:A006
9390 280 70112	WASHER 56359D (TO-220) INSUL	8.0 EA	
9390 272 20112	WASHER 56360A (TO-220) LOAD	8.0 EA	
943 5396 721	HEATSINK	1.0 EA	
3913 080 52310	SPCR RND THRU M4 X 6 BRASS NI	4.0 EA	
2522 178 15085	SCR PNPZ ST18-8 M4X16	4.0 EA	
2522 600 17026	WSH PLN FRM A 18-8 M4	4.0 EA	
2513 712 02005	WSH CRKL ST 18-8 M4	4.0 EA	
2522 178 15062	SCR PNPZ ST18-8 M3X12	6.0 EA	
2513 712 02004	WSH CRKL ST 18-8 M3	8.0 EA	
410 0414 000	THERMAL PAD 1"X0.8"X0.006"	2.0 EA	
2413 490 90116	SIL-PAD TO-220 X 0.012"	6.0 EA	

WARNING: Disconnect primary power prior to servicing.

2522 178 15064	SCR PNPZ ST18-8 M3X16	2.0 EA	

Table 7-111. COMBINER 8 WAY SIGMA++ - 992 9737 097

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
992 9415 040	COMBINER 8 WAY SIG (MECH KIT)	1.0 EA	
2413 031 00351	SKT RF N PANEL 50R	8.0 EA	130
2513 706 07121	CLIP HOSE ST ST 35-50MM	2.0 EA	470
2513 706 07113	CLIP HOSE ST ST 90-120MM	1.0 EA	191
2513 658 15118	PIN SPIRL STNI M2X10	1.0 EA	195
2513 658 05116	PIN SPIRL ST/ST CHR M1X6	2.0 EA	196
2522 178 15135	SCR PNPZ ST18-8 M6X25	4.0 EA	140
2522 178 15133	SCR PNPZ ST18-8 M6X16	12.0 EA	150
2522 178 15057	SCR PNPZ ST 18-8 M3X5	32.0 EA	160
2522 006 01209	SCR SKTCAP 18-8 M5X16	1.0 EA	230
2522 179 64178	SCR CSKPZ 18-8 M5X10	6.0 EA	240
2522 613 06104	WSH S/COIL TYPE-B M5	1.0 EA	200
2513 712 02007	WSH CRKL ST 18-8 M6	12.0 EA	180
1322 511 41801	LOCTITE STUDLOCK 270	0.0 EA	AS REQUIRED
2513 712 02004	WSH CRKL ST 18-8 M3	32.0 EA	190
0613 163 01001	SOLDER 3MM DIA PLUMBSOL	0.0 RL	AS REQUIRED
2522 401 50013	NUT FULLHEX ST18-8 M6	4.0 EA	

Table 7-112. LOAD ASSY 3 WAY SIGMA++ - 992 9737 098

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
3913 468 13280	CABLE ASSY (990MM STRAIGHT	2.0 EA	015
3913 461 45540	LABEL BERYLLIA WARNING 15 X 30	1.0 EA	420
3913 081 65300	LABEL 15MM HAZARD-TOXIC	1.0 EA	430
943 5396 728	HEATSINK-DUMP LOAD	1.0 EA	020
3913 464 15880	SPACER DUMP LOAD	2.0 EA	030
700 1416 000	ATTENUATOR 40DB, 1KW	1.0 EA	040
3913 464 17450	SCREEN	2.0 EA	050
3913 461 77440	PCB DUMP LOAD	2.0 EA	060
2522 178 15067	SCR PNPZ ST18-8 M3X30	10.0 EA	460
3913 464 19480	CABLE SUPPORT	1.0 EA	090
2522 615 04005	WSH LOCK INT 18-8 M3	4.0 EA	095
2522 178 15059	SCR PNPZ ST 18-8 M3X8	4.0 EA	100
2522 178 15058	SCR PNPZ ST 18-8 M3X6	16.0 EA	110
2522 187 02044	SCR CSKSL 18-8 M2.5X6	8.0 EA	120
2522 401 60064	NUT FULHEX ST18-8 M2.5	8.0 EA	210
2513 712 02004	WSH CRKL ST 18-8 M3	30.0 EA	300
2513 712 02003	WSH CRKL ST 18-8 M2.5	8.0 EA	310
2122 900 00171	RES 50R 5% 250W B/OXIDE (TERM	2.0 EA	400
2522 178 15061	SCR PNPZ ST18-8 M3X10	4.0 EA	410
2422 015 05024	TIE CABLE 2.5 X 100 NYLON NAT	2.0 EA	
2522 600 17017	WSH PLN FRM A 18-8 M3	10.0 EA	440

WARNING: Disconnect primary power prior to servicing.

Table 7-113. ISOLATED SUPPLIES 2 PCB ASSY - 992 9080 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
839 8121 288	SCHEM ISOLATED SUPPLIES 2	0.0 EA	EEV TUBES
839 8121 805	SCHEM ISOLATED SUPPLIES 2 (K2)	0.0 EA	CPI TUBES
3913 461 78760	PCB ISOLATED SUPPLIES 2	1.0 EA	010
4322 020 02060	SPACER CER 7.00 X 1.3MM *	64.0 EA	015
2413 490 01046	HEATSINK TV-5	3.0 EA	020
2413 490 01094	HEATSINK TV-21 FOR TO-220	7.0 EA	160 170
2422 016 05019	SADDLE FOR 7.9MM TY-RAP	2.0 EA	025
402 0201 000	HOLDER FUSE CLIP DUAL SIZE	6.0 EA	030
2422 015 05069	TIE CABLE 3.5 X 150 NYLON NAT	2.0 EA	035
2432 020 00048	SKT RF BNC PCB MGT 50R	1.0 EA	X011:
2413 015 00864	TERM SL4-V	1.0 EA	X001:
3913 935 00045	REG 79L15 -15V 0.1A TO92	1.0 EA	A001:
9335 613 10682	IC RC4558P-00	1.0 EA	A002:
3913 935 00007	REG 7812 +12V 1.5A TO-220	1.0 EA	A101:
9334 636 90742	IC LM7912CT	1.0 EA	A102:
382 1347 000	IC LP311N (DIL-8)	2.0 EA	0000 A103:A104:
506 0266 000	CAP 1U 20% 250V PP	2.0 EA	0000 C001:C002:
2000 101 06478	CAP 4U7 25V ELSOL RAD/WIRE	1.0 EA	C205
524 0364 000	CAP 470U 385V ELECT	1.0 EA	C003:
524 0363 000	CAP 100U 385V ELECT	1.0 EA	C004:
506 0271 000	CAP 100N 10% 400V PETP 15MM	3.0 EA	C005:C009:C119
2012 310 03124	CAP 330N 10% 63V PSTR 0.2" P	1.0 EA	C006
2012 310 03162	CAP 1U0 10% 50V PSTR 0.2" P	5.0 EA	C008:C110;C111:C010: C011:
522 0602 000	CAP 3300U 25V ELECT PCB MGT	2.0 EA	C101:C102:
2012 310 00318	CAP 100N 10% 63V PSTR 0.2"	9.0 EA	C007:C012:C013: C114:C115:C116:C117: C118:C120
2222 683 34151	CAP 150P 2% 100V N150 0.2"	3.0 EA	C123:C124:C125
3913 200 10052	CAP 100N -20+80 50V CER	3.0 EA	0000 C103:C104:C109:
2222 030 36109	CAP 10U 25V ELECT	2.0 EA	0000 C105:C106:
2013 017 01543	CAP 10U 20% 16V TANT	4.0 EA	0000 C107:C108:C121:C122
8213 268 75169	CAP 47N 3KV +-5% PAPER	1.0 EA	C201:
2422 086 01015	FUSE 500MA T 5X20 LBC IEC127-3	1.0 EA	F001:
2422 086 01005	FUSE 100MA T 5X20 LBC IEC127-3	1.0 PK	F002:
2422 086 00013	FUSE 160MA F 5X20 LBC IEC127-2	1.0 EA	0000 F003:
9338 827 15682	OPTO/TX HFBR-1522	5.0 EA	0000 H001:H101;H102;H103: H104
9332 897 10682	LED 5MM HLMP-3507 GRN	2.0 EA	0000 H105:H106:
2122 550 00035	RES VD 220V 0.8W 24MM DIA	2.0 EA	R042:R043
2113 256 02641	RES 0R47 5% 2W5 W/W	2.0 EA	0000 R001:R002:
2113 256 02255	RES 4R7 5% 2W5 W/W	2.0 EA	R128:R129
2113 256 01466	RES 47R 5% 9W W/W	1.0 EA	R003:
2322 156 12701	RES 270R 1% 0W6 MTLFLM	1.0 EA	R007
560 0092 000	RES VD 14V RMS 100J 20MM DIA	3.0 EA	R124:R127:R215
2322 156 13902	RES 3K9 1% 0W6 MTLFLM	1.0 EA	R006
2113 256 01041	RES 20K 5% 6W W/W	1.0 EA	R044
2113 256 02336	RES 4K7 5% 6W W/W	2.0 EA	R004:R207:
2113 256 02152	RES 470R 5% 12W W/W	1.0 EA	R045
2322 156 11502	RES 1K5 1% 0W6 MTLFLM	1.0 EA	R130: AOT 1K5 FOR EEV TUBES 1K8 FOR CPI TUBES
2113 256 02147	RES 330R 5% 12W W/W	1.0 EA	R046
2322 156 13901	RES 390R 1% 0W6 MTLFLM	2.0 EA	R111:R115:
2322 156 17508	RES 7R5 1% 0W6 MTLFLM	1.0 EA	R047
2113 256 02335	RES 3K9 5% 6W W/W	1.0 EA	R005
2322 156 11002	RES 1K 1% 0W6 MTLFLM	4.0 EA	0000 R011:R025:R026:R107

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2322 156 19101	RES 910R 1% 0W6 MTLFLM	1.0 EA	R131: AOT 910R FOR EEV TUBES 390R FOR CPI TUBES
2113 111 22473	RES 47K 2% 2W0 MTLOX	1.0 EA	R009:
2322 156 13301	RES 330R 1% 0W6 MTLFLM	4.0 EA	R010:R027:R028:R041
2322 156 12002	RES 2K 1% 0W6 MTLFLM	2.0 EA	R012:R109:
2113 111 25133	RES 12K 2% 1W0 MTLOX	1.0 EA	R013
2322 156 11003	RES 10K 1% 0W6 MTLFLM	7.0 EA	R029:R036: R037:R121 R122:R123:R110:
2322 156 12003	RES 20K 1% 0W6 MTLFLM	1.0 EA	R030
2113 111 25103	RES 10K 2% 1W0 MTLOX	1.0 EA	R015:
2122 362 00159	POT 10K 10% LIN W5 TOP ADJ	1.0 EA	R038:
2113 111 00265	RES 6K8 2% 1W0 MTLOX	1.0 EA	R014:
2113 256 02265	RES 150R 5% 2W5 W/W	6.0 EA	0000 R016:R017:R018:R019: R020:R021:
2322 156 11001	RES 100R 1% 0W6 MTLFLM	2.0 EA	0000 R022:R024:
2322 156 11009	RES 10R 1% 0W6 MTLFLM	4.0 EA	R101:R102:R125:R126
2113 256 02257	RES 10R 5% 2W5 W/W	1.0 EA	R023:
2322 156 16801	RES 680R 1% 0W6 MTLFLM	1.0 EA	R040:
2322 156 15603	RES 56K 1% 0W6 MTLFLM	1.0 EA	R031:
2322 156 14704	RES 470K 1% 0W6 MTLFLM	4.0 EA	0000 R032:R033:R034:R035:
2322 156 11005	RES 1M 1% 0W6 MTLFLM	1.0 EA	R039
2322 156 11004	RES 100K 1% 0W6 MTLFLM	1.0 EA	R213:
2322 156 11504	RES 150K 1% 0W6 MTLFLM	1.0 EA	R103:
2322 156 12203	RES 22K 1% 0W6 MTLFLM	1.0 EA	R104:
2322 156 13002	RES 3K 1% 0W6 MTLFLM	1.0 EA	R214
2322 156 14302	RES 4K3 1% 0W6 MTLFLM	1.0 EA	R105
2322 156 19109	RES 91R 1% 0W6 MTLFLM	3.0 EA	0000 R106:R108:R132
2322 156 12001	RES 200R 1% 0W6 MTLFLM	2.0 EA	0000 R112:R113:
2322 156 14701	RES 470R 1% 0W6 MTLFLM	2.0 EA	0000 R116:R117:
2322 156 16202	RES 6K2 1% 0W6 MTLFLM	1.0 EA	R201:
548 2343 000	RES 500K 1W3 1 1.9397E-320C70 SERIES	10.0 EA	0000
2322 241 13106	RES 10M 5% 0W25 MTLGLZ	2.0 EA	R118:R119
2122 362 00158	POT 5K0 10% LIN W5 TOP ADJ	1.0 EA	R120
2322 156 19102	RES 9K1 1% 0W6 MTLFLM	1.0 EA	R114: AOT 9K1 FOR EEV IOT 12K FOR CPI KLYSTRD
9338 828 06682	RECTFR 1B08 (800V-1A)	1.0 EA	V002:
380 0746 000	TRANS MPSA92	3.0 EA	0000 V003:V004:V009:
9330 473 10112	DIODE 1N916	16.0 EA	V005:V006:V007:V008: V020:V021: V022:V023:V025:V206: V110:V111 V112:V113:V114:V115
9338 828 08682	TRANS MJE5731 (PNP) (TO-220)	3.0 EA	0000 V010:V011:V012:
380 0747 000	TRANS MPSA42	4.0 EA	0000 V013:V017:V018:V019:
9338 828 07682	TRANS TIP49 (NPN) (TO-220)	5.0 EA	0000
9338 828 07682	TRANS TIP49 (NPN) (TO-220)	5.0 EA	V014:V015:V016: V033:V034
386 0459 000	DIODE BZW50-150	2.0 EA	0000 V024:V027
9338 820 00682	RECTFR 1B01 (100V 1Amp)	1.0 EA	V101:
9331 176 70112	DIODE BZX79C3V3	1.0 EA	V116
9331 177 70112	DIODE BZX79C8V2	1.0 EA	0000 V102
9331 178 10112	DIODE BZX79C12	1.0 EA	V105
9330 791 70702	TRANS 2N3906 (TO-92)	1.0 EA	V103:
9336 508 70682	TRANS BS170 (TO-92)	1.0 EA	V026
9331 177 20112	DIODE BZX79C5V1	2.0 EA	0000 V104:V204:
384 0793 000	TRANSZORB SA15 15V	3.0 EA	V031:V108:V109
9330 745 40702	TRANS 2N3904 (TO-92)	2.0 EA	V107:V117
384 0020 000	DIODE 1N4004	4.0 EA	V028:V029:V030:V032
9331 177 00112	DIODE BZX79C4V3	1.0 EA	V106
9331 176 80112	DIODE BZX79C3V6	1.0 EA	V205:

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384 0268 000	RECT 7.5KV PIV	2.0 EA	0000 V202:V203:
2413 015 14086	TAB 6.3mm Vertical PCB MTG	20.0 EA	0000 X007:X008:X012:X013: X4/1:X4/2:X4/3;
2413 015 14086	TAB 6.3mm Vertical PCB MTG	20.0 EA	X006:X005:X010:X009: X002:X003:
2422 015 12168	TERM INSULUG M5 RED	2.0 EA	120
2422 015 12808	TERM PUSH-ON 6.3 x 0.5MM RED	2.0 EA	130
2522 178 15105	SCR PNPZ ST18-8 M5X10	2.0 EA	040
2522 178 15059	SCR PNPZ ST 18-8 M3X8	3.0 EA	080
2522 401 50012	NUT FULLHEX ST18-8 M5	2.0 EA	070
2522 401 50008	NUT FULLHEX ST18-8 M3	15.0 EA	090
2513 712 02006	WSH CRKL ST18-8 M5	4.0 EA	050
2513 712 02004	WSH CRKL ST 18-8 M3	15.0 EA	110
2522 600 79029	WSH PLN A ST 18-8 M5	2.0 EA	060
2522 600 79017	WSH PLN A ST18-8 M3	21.0 EA	100
2413 015 14168	TAG SOLDER PCB TAIL 2.5 X 0.9M	14.0 EA	101
2522 178 13059	SCR PNPZ ST 18-8 M3X8	6.0 EA	
2522 178 15062	SCR PNPZ ST18-8 M3X12	6.0 EA	
917 2336 078	LABEL - ISOL.P/S. FUSE VALUES	1.0 EA	

Table 7-114. MODE CONTROLLER ASSY - 992 8813 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
817 2336 125	MODE CONTRLLR 2 TUBE CONFIGURA	0.0 EA	
817 2336 126	MODE CONTRLLR 3 TUBE CONFIGURA	0.0 EA	
817 2336 127	MODE CONTRLLR 2 TUBE+STANDBY	0.0 EA	
817 2336 128	MODE CONTRLLR 4 TUBE CONFIGURA	0.0 EA	
817 2336 160	MODE CONTRLLR DH120 E3 CONFIGU	0.0 EA	
817 2336 161	MODE CONTRLLR HD240 E5 CONFIGU	0.0 EA	
839 8121 161	SCHEM MODE CONTROLLER	0.0 EA	
839 8121 169	SCHEM MODE CONTROLLER	0.0 EA	
992 8933 001	MODE CONTROLLER PCB LOCAL ASSY	1.0 EA	0010
992 8934 001	MODE CONTROLLER P.C.B. ASSY.	1.0 EA	0015
943 5396 137	SET OF RIBBON CABLES MODE CONT	1.0 EA	0020
646 1537 000	PANEL-MODE CONTROL OVERLAY	1.0 EA	0025
943 5396 711	SUPPORT - MODE CONTROL	1.0 EA	
306 0004 000	NUT FULL 6-32 SST	10.0 EA	
310 0038 000	WASHER PLAIN No;6 SST	10.0 EA	
314 0005 000	SPLIT LOCK WASHER No;6 SST	10.0 EA	
3913 080 52310	SPCR RND THRU M4 X 6 BRASS NI	10.0 EA	

Table 7-115. MODE CONTROLLER P.C.B. ASSY. - 992 8934 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
839 8121 161	SCHEM MODE CONTROLLER	0.0 EA	
3913 461 78560	PCB MODE CONTROLLER	1.0 EA	010
382 0774 000	IC 74HC14 HEX SCHMIDT (DIL-14	8.0 EA	0000 A001:A002:A019:A027: A036:A039:A046:A068:
382 1070 000	OPTO COUPLER ILQ-1	5.0 EA	0000 A003:A004:A024:A025: A026:
382 0771 000	IC 74HC08 2 I/P AND (DIL-14	10.0 EA	0000 A005:A006:A007:A018: A031:A032: A037:A044:A060:A069:
382 0778 000	IC 74HC32 4X 2 I/P OR (DIL-14	5.0 EA	0000 A008:A009:A010:A033: A035:
382 0865 000	IC 74HC4538 MONSTBL (DIL-16	2.0 EA	0000 A011:A063:
382 0798 000	IC 74HC158 2I/P M/INV (DIL-16	3.0 EA	0000 A012:A013:A014:
3913 935 12117	IC 74HC148 ENCODEER (DIL-16)	1.0 EA	0000 A015:
3913 935 12118	IC 74HC237 DCODER (DIL-16)	1.0 EA	0000 A017:

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382 0897 000	IC ULN2803A	6.0 EA	0000 A020:A023:A034:A042: A064:A065:
382 0832 000	IC 74HC373 OCTAL LTCH (DIL-16	2.0 EA	0000 A021:A022:
382 0854 000	IC 74HC4060 CNTR (DIL-16	1.0 EA	0000 A028:
382 0777 000	IC 74HC30 8I/P NAND (DIL-14)	21.0 EA	0000 A016:A038:A040:A041: A043:A045:A047:A048: A049:A050:A051:A052: A053:A054:A055:A056: A057:A058:A059:A066: A067:
614 0844 000	TERM BL10	5.0 EA	X014:X013:X011:X006 X007
516 0760 000	CAP 100N 20% 50/63V X7R SIP8	1.0 EA	0000 C001:
614 0842 000	TERM BL4	4.0 EA	X009:X004 X012:X016
506 0233 000	CAP 100N 10% 63V PSTR 0.2"	65.0 EA	0000 C005:C010:C011:C012: C013:C014:C015:C016: C017:C018:C020:C022: C024:C025:C026:C027: C028:C030:C032:C033: C034:C035:C036:C038: C039:C040:C041:C042: C043:C044:C045:C046: C047:C048:C049:C050: C051:C052:C053:C054: C055:C056:C057:C058: C059:C060:C061:C062:
506 0233 000	CAP 100N 10% 63V PSTR 0.2"	65.0 EA	C063:C064:C065:C066: C067:C068:C069:C070: C072:C075:C076:C081: C077:C078:C079:C080: C082:
2000 101 06228	CAP 2U2 25V ELSOL RAD/WIRE	1.0 EA	0000 C083:
2013 017 01607	CAP 10U 20% 50V TANT	2.0 EA	0000 C019:C021:
2000 101 03229	CAP 22U 10V ELSOL RAD/WIRE	3.0 EA	0000 C029:C071:C074:
506 0277 000	CAP 1U0 20% 63V PSTR 0.2" P	2.0 EA	0000 C023:C031:
506 0232 000	CAP 10N 20% 100V PSTR 0.2" P	1.0 EA	0000 C037:
2400 086 00016	FUSE 10A T 5X20 HRC CER	4.0 EA	F001:F002:F003:F004
402 0201 000	HOLDER FUSE CLIP DUAL SIZE	8.0 EA	0000 F001:F002:F003:F004:
384 0610 000	LED 5MM HLMP-3507 GRN	4.0 EA	0000 H001:H002:H003:H004:
2400 131 00022	RELAY 24V 2 CO 2A BISTBL PCB M	2.0 EA	0000 K001:K011:
2400 131 00015	RELAY 24VDC 1P C/O 16AMP (5mm	13.0 EA	0000 K002:K003:K004:K005: K006:K007:K008:K009: K010:K014:K015:K016: K013:
540 1534 000	RES NWORK 4K7 X8 SIL9	2.0 EA	0000 R001:R023:
3913 017 01430	RES NWORK 100K X8 DIL16	1.0 EA	0000 R002:
3913 017 01420	RES NWORK 330R X8 DIL16	2.0 EA	0000 R003:R004:
548 2309 000	RES 4K7 1% 0W6 MTLFLM	6.0 EA	0000 R009:R011:R024:R062: R073:R048:
2322 156 14709	RES 47R 1% 0W6 MTLFLM	1.0 EA	0000 R079:
548 0483 000	RES 100K 1% 0W6 MTLFLM	9.0 EA	0000 R010:R012:R030:R033: R047:R075:R076:R028: R046:
2322 241 13225	RES 2M2 5% 0W25 MTLGLZ	1.0 EA	0000 R083:
548 2303 000	RES 330R 1% 0W6 MTLFLM	4.0 EA	0000 R016:R042:R055:R056:
2322 156 12004	RES 200K 1% 0W6 MTLFLM	2.0 EA	0000 R080:R081:
548 1121 000	RES 10K 1% 0W6 MTLFLM	1.0 EA	0000 R022:
548 2291 000	RES 220R 1% 0W6 MTLFLM	2.0 EA	0000 R025:R035:
548 2286 000	RES 1K2 1% 0W6 MTLFLM	5.0 EA	0000 R026:R036:R029:R034: R082:
548 2310 000	RES 470K 1% 0W6 MTLFLM	3.0 EA	0000 R027:R031:R059
548 2294 000	RES 220K 1% 0W6 MTLFLM	1.0 EA	0000 R032:
540 1542 000	RES NWORK 47K X8 SIL9	1.0 EA	0000 R084:
540 1538 000	RES NWORK 10K X8 SIL9	1.0 EA	0000 R057:

3913 017 01080	RES NWORK 10K X5 SIL6	1.0 EA	0000 R058:
2322 156 17504	RES 750K 1% 0W6 MTLFLM	1.0 EA	0000 R049:
3913 017 00220	RES NWORK 470K X8 SIL9	13.0 EA	0000 R060:R063:R064:R065: R066:R067:R068:R069: R070:R071:R074:R077: R078:
2322 156 16804	RES 680K 1% 0W6 MTLFLM	1.0 EA	0000 R061:
604 1153 000	SWITCH P/B 2P MOM GOLD	1.0 EA	0000 S001:
2400 127 00005	SWITCH DIL 8 POLE C/O SPDT	8.0 EA	0000 S002:S003:S004:S005: S006:S007:S008:S009:
604 0851 000	SWITCH DIL 8 POLE SPST	13.0 EA	0000 S010:S011:S012:S013: S014:S015:S016:S017: S018:S019:S020:S021: S022:
384 0789 000	TRANSZORB SA5.0 5V	1.0 EA	0000 V001:
9338 827 87682	DIODE 31DQ06 (C-16)	4.0 EA	0000 V002:V003:V005:V006:
9338 827 39682	TRANSZORB SA24 24V	1.0 EA	0000 V004:
384 0307 000	DIODE 1N916	3.0 EA	0000 V007:V008:V009:
612 1419 000	SKT 37WAY D TYP PCB MTG	1.0 EA	0000 X001:
610 0900 000	HEADER 1 X 3	1.0 EA	0000 X002:
614 0849 000	TERM SL4-V	5.0 EA	0000 X003:X004:X009:X012: X016:
3913 240 10017	HEADER 26 WAY LTCH STRGHT STD	1.0 EA	0000 X005:
614 0852 000	TERM SL10-V	5.0 EA	0000
614 0852 000	TERM SL10-V	5.0 EA	X006:X007:X011:X013: X014:
610 1070 000	HEADER 2 X 3	1.0 EA	0000 X008:
610 1192 000	PLUG 37WAY D TYP PCB MTG	1.0 EA	0000 X010:
610 1215 000	HEADER 10 WAY LTCH STRGHT STD	1.0 EA	0000 X015:
612 1184 000	SKT 2 WAY 2.54MM PITCH	2.0 EA	520
2432 490 00004	SKT DIL 18WAY x 0.3" FL/FRAME	2.0 EA	FOR A020:A042
404 0675 000	SKT DIL 16WAY x 0.3" FL/FRAME	5.0 EA	FOR A003:A004:A024 A025:A026
358 1214 000	JACKSOCKET D TYP (PAIR)	2.0 EA	530
3913 080 52250	SPCR RND THRU M3 X 6 BRASS NI	4.0 PK	540

Table 7-116. MODE CONTROLLER PCB LOCAL ASSY - 992 8933 001

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYMBOLS/EXPLANATIONS*
839 8121 162	WIRING DIAG LOCAL CTRL	0.0 EA	
3913 461 78570	PCB MODE CONTROLLER LOCAL	1.0 EA	010
384 0906 000	LED MV54124 GRN	10.0 EA	0000 H001:H002:H003:H004: H005:H006:H007:H008: H009:H010:
540 1536 000	RES NWORK 220R X8 SIL9	1.0 EA	0000 R001:
548 2291 000	RES 220R 1% 0W6 MTLFLM	2.0 EA	0000 R002:R003:
604 1141 000	SWITCH P/B MEMBRANE	10.0 EA	0000 S001:S002:S003:S004: S005:S006:S007:S008: S009:S010:
3913 240 10017	HEADER 26 WAY LTCH STRGHT STD	1.0 EA	0000 X001
598 0450 000	CAP SPACING W/ 2 HOLES	10.0 EA	

WARNING: Disconnect primary power prior to servicing.

Appendix A
Cutting and Soldering Transmission Line

a.1 Suggested Procedure For Cutting And Soldering Transmission Line

The purpose for this procedure is to provide guidelines for field cutting and soldering of RF transmission line used to interconnect the transmitter to the RF system.

Try to cut and flange the longest pieces first. Complete one run at a time in order to avoid accumulated errors. (i.e.: Cut, solder, and hang line from antenna port of Bandpass filter to patch panel. Then cut, solder, and hang line from the Amplifier output to the input port of the bandpasss filter.)

Listed in Table a-1 are some tools and materials that have proven effective for RF Feed Line Construction.

Table a-1. Installation Tools *and Materials*

Welding Torch Set
Oxygen and Acetylene Tanks
Welder's Mask or Goggles
Power Band Saw (can be rented) and Extra Blades
Silver Solder 1/16 inch diameter, 30%-45%, Hard Stay-Silv #45, Aladdin #45, HARRIS part number 099 0002 238
Paste flux (Engelhard Ultra-Flux 1 lb jar) HARRIS part number 099 0002 241
(HARRIS part number 086 0004 040, 16 oz bottle)
Muriatic Acid (quart)
Baking Soda (two 1-pound boxes)
Three plastic 5-gallon buckets or containers with open tops
Scotch Brite
Steel Wool
Emery Cloth (roll type like plumber uses)
Carpenters Square
Level
Plumb Bob
Chalk Line
Hacksaw and Extra Blades
Wrenches
Crowbar
Rope
Saw Horses or Cutting Table
Come-along or Chain-Fall Hoist
Ladders
Files
Garden Hose
25-Ft Tape Measure
Hole Saw, 1-7/8 inches, for installing directional couplers
Rubber Hammer
Claw Hammer
Gloves
Safety Glasses
NOTE: All-thread rod, hangers, angle iron or channel will be needed to support the transmission line, dummy load, etc.

a.2 Transmission Line Cutting and Flange Soldering Procedure

a. Determine the flange-face to flange-face length of the transmission line run needed. (If the run includes an elbow, see Figure a-2 to determine the elbow length.)

b. Subtract twice the cutback dimension of the flange. This dimension varies with flange manufacturer. See Figure a-1. Using the suggested methods for cutting the line given in paragraph a.3, cut the outer conductor to the length just calculated.

c. If holes in the outer conductor are needed for directional couplers, tuning paddles, etc. they should be added now with the holes properly deburred.

d. Using the suggested techniques for installing the flanges given in paragraph a.4, solder a flange to each end of the outer conductor.

e. Measure the flange-face to flange-face dimension after soldering to confirm the proper length and to determine the initial length of the inner conductor.

f. Determine the length of the inner conductor by using the flange-face to flange-face dimension of the outer conductor and subtracting the dimension of the anchor connector (bullet) shown in Figure a-3. This dimension determines the proper cutback of the inner conductor for BOTH ENDS OF THE LINE AT THE SAME TIME. DO NOT DOUBLE THIS DIMENSION WHEN SUBTRACTING FROM THE OUTER CONDUCTOR LENGTH.

g. Cut the inner conductor and deburr the cut edges.

h. Ensure the inside of the outer conductor is clean; then insert the inner conductor. The line is ready to install.

a.3 Cutting The Transmission Line

A square smooth cut is required. Several methods may be used with the choice depending on tools and labor available.

a. METHOD #1. A hand hack saw and cast iron cutting guide are a good combination for making a cut with a minimum of tools for one or two pieces, but can be very labor intensive for putting up an entire system. See Figure a-4.

b. METHOD #2. Hand Band Saw. These popular saws can be rented or purchased. See Figure a-5.

c. METHOD #3. Swing Arm Band Saw. This is a good way to go if one can be rented or borrowed. Many pipe fitters and electrical contractors own them. If the saw has an automatic feed, cut slowly. It is critical that the support saw horses be made level with the saw. Test cuts should first be made using scrap pipe or a wood 4x4 to verify that the blade is not creeping and the saw is in alignment. See Figure a-6.

WARNING: Disconnect primary power prior to servicing.

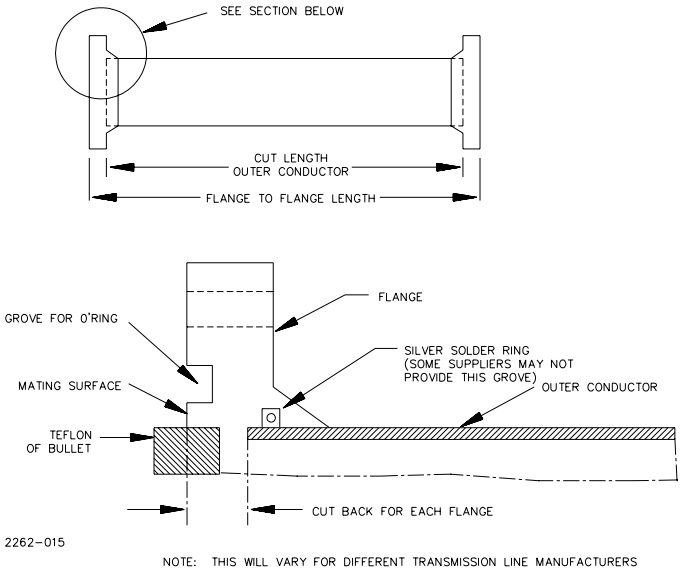

Figure a-1. Outer Conductor Measurements

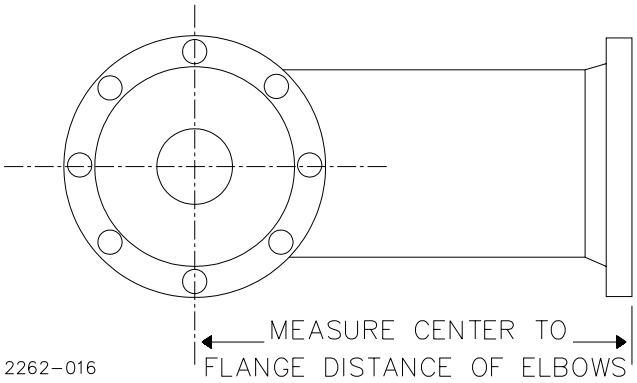

Figure a-2. Measurements When Elbows Are Used

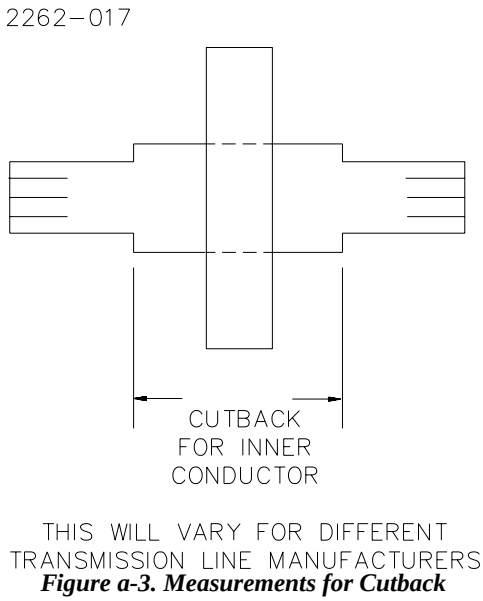

Figure a-3. Measurements for Cutback of Inner Conductor

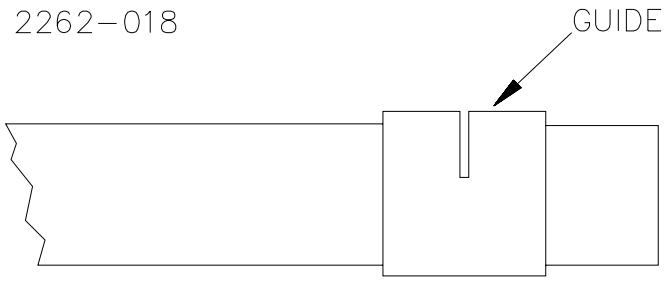

Figure a-4.Guide For Use With Hand Hack Saw

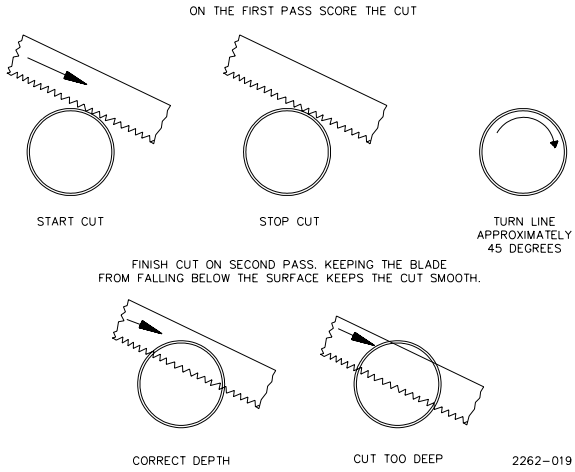

Figure a-5. Cutting with Hand Band Saw

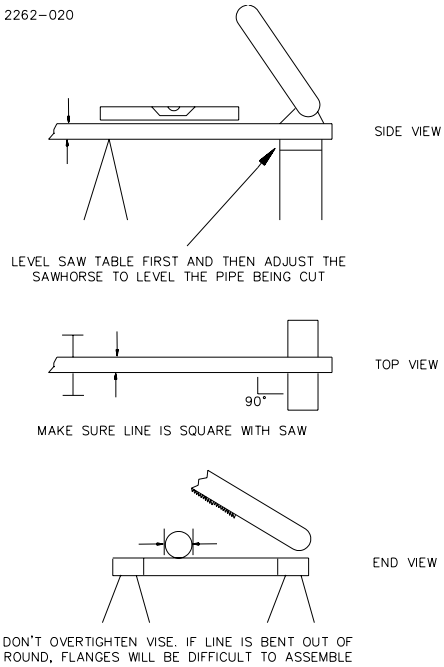
2262-020
SIDE VIEW
LEVEL SAW TABLE FIRST AND THEN ADJUST THE
SAWHORSE TO LEVEL THE PIPE BEING CUT
TOP VIEW
90°
MAKE SURE LINE IS SQUARE WITH SAW
END VIEW
DON'T OVERTIGHTEN VISE. IF LINE IS BENT OUT OF
ROUND, FLANGES WILL BE DIFFICULT TO ASSEMBLE

Figure a-6. Swing Arm Band Saw Cutting Tips

WARNING: Disconnect primary power prior to servicing.

C

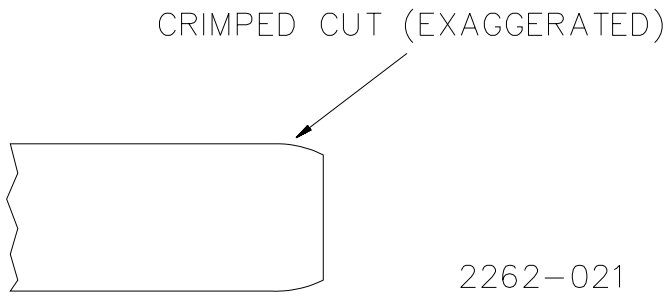

Figure a-7.
Crimped Cut (Exaggerated)

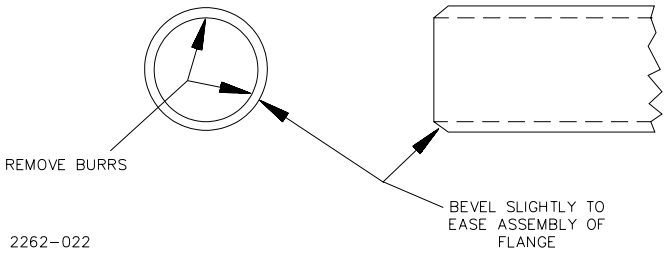

Figure a-8.
Bevel and Remove Burrs

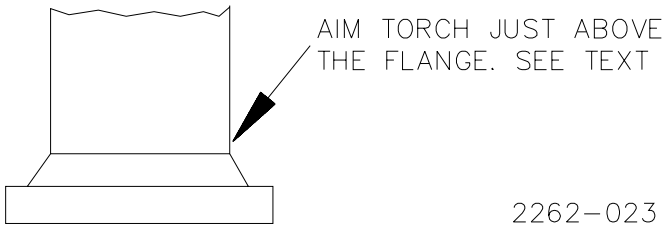

Figure a-9.
Torch Aiming Location

AUTION

DO NOT OVER TIGHTEN THE VISE USED WITH THESE SAWS. IT WILL BE DIFFICULT TO PUT THE FLANGE ON AN OUT OF ROUND PIPE.

d. METHOD #4. Tubing Cutter. This is generally not recommended. Many cuts end up with crimped ends due to dull cutters or trying to cut too fast. Use with caution. Avoid if possible unless someone is available that has had a lot of experience using a tubing cutter on this type of installation. See Figure a-7.

e. METHOD #5. Cut Off Saw. These saws are similar to radial arm saws. It is rare to find one big enough to cut 6-1/8" line. The set up is similar to the swing arm band saw. See Figure a-6.

a.4 Soldering Transmission Line Flanges

Transmission line flanges that are supplied with the optional transmission line kit are the silver solder type. Although the attachment of this type of flange may require more care and skill than the soft solder type, it has been found that the silver soldered flange provides much greater reliability. The services of a steam fitter or plumber may be helpful if personnel are not available that are experienced with silver soldering.

a.4.1 Soldering Procedure

a. The line should be free of burrs. The outer corner may be beveled slightly to make assembly of flange easier. See Figure a-8.

b. Emery cloth should be used to clean the outside of the line where it will meet the flange. Also clean the inner surface of the flange with emery cloth.

c. Insert the solder ring into the groove on the flange. If solder rings are not included with the flange, they can be made from .062-inch diameter silver solder wire (30-45% silver).

d. Apply a thin coat of flux to the line and to the flange.

e. Slide the flange onto the end of the outer conductor.

WARNING

SKIN BURN HAZARD. TEMPERATURE OF THE HEATED LINE IN THE FOLLOWING STEPS IS QUITE HIGH AND PRECAUTIONS MUST BE TAKEN TO AVOID CONTACT WITH EXPOSED SKIN.

f. Stand the line on end (vertical) for soldering (flange to be soldered pointing down). Ensure that the flange remains square with the outer conductor.

g. Using a #3 or #4 torch tip, heat the entire circumference of the line and flange. Keep the torch moving and heat 2 or 3 inches of the line/flange at a time. Aim the torch at the copper just above the crack between the flange and the line. This will minimize the need for fill solder. If the brass flange is heated more than the copper line, the flange will expand and create an unnecessary gap to fill with solder. Use caution. There is a fine line between melting the solder and melting the brass flange or burning a hole in the copper. The solder will pull up into the joint from the solder ring by capillary action. Once it starts to flow, do not stop until the entire circumference of the joint has solder appearing in it. If the solder from the internal solder ring does not "wick up" and become visible at the joint after a few minutes, a small amount of solder can be applied to the joint to enhance the heat transfer. See Figure a-9.

WARNING: Disconnect primary power prior to servicing.

a.5 Cleaning The Soldered Joint

Vigorous scrubbing with a wire brush and steel wool will remove torch black with good results. In addition, cleaning with an acid solution can make this job easier. The procedure is as follows:

WARNING

MURIATIC ACID USED IN THE FOLLOWING PROCEDURE IS HAZARDOUS. USE EYE AND SKIN PROTECTION WHEN HANDLING OR MIXING. KEEP AN EXTRA BOX OF BAKING SODA HANDY FOR FIRST AID OR TO NEUTRALIZE SPILLS. PERFORM THE PROCEDURES OUTDOORS IF POSSIBLE. IF THE WORK MUST BE DONE INDOORS, WORK ONLY IN WELL VENTILATED AREA.

WARNING

IN THE FOLLOWING MIXING PROCEDURE, ALWAYS PUT WATER IN THE CONTAINER FIRST AND THEN ADD ACID TO THE WATER. ADDING WATER TO A CONTAINER OF ACID MAY RESULT IN A VIOLENT & DANGEROUS REACTION.

a. Prepare three plastic 5 gallon buckets as follows:
   1. Bucket #1 - Water
   2. Bucket #2 - One quart muriatic acid in four gallons of water (SEE WARNINGS ABOVE)
   3. Bucket #3 - One pound baking soda in five gallons of water
b. After soldering is finished, dip the end of the line in the water to cool.
c. Set the cooled end of the line into the acid-water mixture for 5-10 minutes. This will loosen the film and brighten the silver.
d. Immerse the end of the line into the soda solution. This will stop the action of the acid.
e. Use a Scotch Bright pad or steel wool to scrub off the remaining torch black.
f. If the flux scale is particularly stubborn repeat the process.
g. Rinse thoroughly when done with water and dry line before assembling.

a.5.1 Alternate Cleaning Method

The following is an alternate procedure to clean the soldered transmission line. The following materials are needed.

- Water and Hose
- Small Paint Brush
- Rubber Gloves
- Scotch Brite Pad or BBQ Grill Cleaning Pad With Handle
- Naval Jelly (or equivalent rust remover)

WARNING

NAVAL JELLY CONTAINS PHOSPHORIC ACID AND CAN BE DANGEROUS IF IT COMES IN CONTACT WITH SKIN OR EYES OR IF IT IS SWALLOWED. READ AND FOLLOW THE PRECAUTIONS AND EMERGENCY PROCEDURES ON THE NAVAL JELLY CONTAINER BEFORE USING.

a. After soldering the flange, dip the end of the line into water or spray it with a hose until it is cool.
b. Using a small paint brush, apply a coating of Naval Jelly to the torch black and flux scale on the outside and inside of the line. Let the Naval Jelly set from 10 to 20 minutes.
c. Scrub the line with Scotch Brite or the BBQ Grill pad to loosen the torch black and flux scale.
d. Flush with water until the Naval Jelly residue is gone.
e. Repeat the process until all the torch black and flux scale is removed.

The first application of the Naval Jelly will remove the torch black and some of the flux scale. Normally, if vigorous scrubbing is done, repeating the process a second time will completely clean the line.

Appendix B
Lightning Protection Recommendation

b.1. Introduction

What do you do with a 2 million volt pulse pushing 220,000 amps of current into your transmitting plant? Like the 500 pound gorilla you let it do what ever it wants to. There is not much that can be done to protect against a major direct lightning strike. This is called a significant impulse lightning stroke. It usually lasts less than 100 microseconds and is most destructive to electronic equipment because it contains huge amounts of high frequency energy.

Here are some examples of this damage:

- Melted ball and horn gaps.
- Ground straps burned loose.
- H.V. rectifier stacks shorted.
- Massive arc marks in the output circuit of AM transmitters.
- Ball lightning traveling into building on outer conductor of transmission line.

Figure b-1 is a map of the United States that shows the number of lightning days you can expect in any year. You fellas in Colorado, New Mexico, and Florida need lightning rods on your hats.

Figure b-2 shows the incidents to tall structures. A triggered event is one that happens because the tower was present. Without the tower the strike would not have occurred.

b.2. Enviornmental Hazards

There are devices and procedures that do offer protection from lessor environmental hazards than lightning. Some of these anomalies are listed and defined:

a. Over voltage/under voltage (brownout). Where the lines voltage differs from the nominal RMS for longer than one cycle.

- Remedy - Automatic voltage regulators, preferably individual regulators on each phase. This can only be accomplished when the power feed line is delta or 4/wire wye connected. (See Figure b-3.)

b. Single phasing. This is where one leg of the three phase service is open.

- Remedy - Protection afforded by a loss of phase detector. Without protection power transformers and 3 phase motors over heat.

c. Radio frequency interference (RFI). This is something we must design into all of our transmitters, however, you may purchase equipment that is susceptible, is not protected, and develop problems.

- Remedy - RFI filters on the ac lines and control lines are sometimes effective. Sometimes the entire device must be enclosed in an RF free space.

d. Electromagnetic pulse (EMP). This is a interfering signal pulse that enters the system by magnetic coupling (transformer). Generally caused by lightning.

- Lightning from cloud to cloud produces horizontally polarized waves while lightning from cloud to earth produce vertically polarized waves. The waves couple into the power lines and transmission lines causing large induced voltage that destroy high voltage rectifier stacks and output circuit faults. High frequency energy is coupled back into the transmitter causing VSWR overloads. (See Figures b-4 & b-5.)
- Remedy - Ball or horn gaps at the base of the antenna prevent the voltage from exceeding some high potential. Transient suppressor devices on the input power lines remove excessive voltage spikes. Buried power and transmission lines will reduce the amount of coupled energy to a great extent. This does not totally eliminate the problem because there are currents traveling in the earth when lightning strikes close to the station which prefer to travel on the metal conductors.

e. Surge. A rapid increase in voltage on the power lines usually caused by lightning. The duration is less than 1/2 cycle and can be very destructive.

- Remedy - Transient protectors are very effective in preventing damage to the equipment when properly designed and installed. (See Figure b-7.)

Significant Lightning Stroke Characteristics	
Charge Range	2 to 200 coulombs
Peak Currents	2,000 to 400,000 Amperes
Rise Time to 90%	300 Nanoseconds to 10 Microseconds
Duration to 50%	100 Microseconds to 10 Milliseconds
Potential Energy at 99%	1010 Joules*
* Only a small portion is manifested in a surge, usually less than 10,000 Joules.	

b.3. What Can Be Done?

Installation of the transmitter building, antenna tuning unit if applicable, and antenna should be done so that the risk of destruction due to lightning is minimal and the efficiency of the over all system is maximized. To do this, separate ground systems should be installed for the building and antenna. This forces all of the RF return currents to flow in the transmission line shield. The coax can be buried below the antenna ground plane to still further reduce the RF current coupled to it.

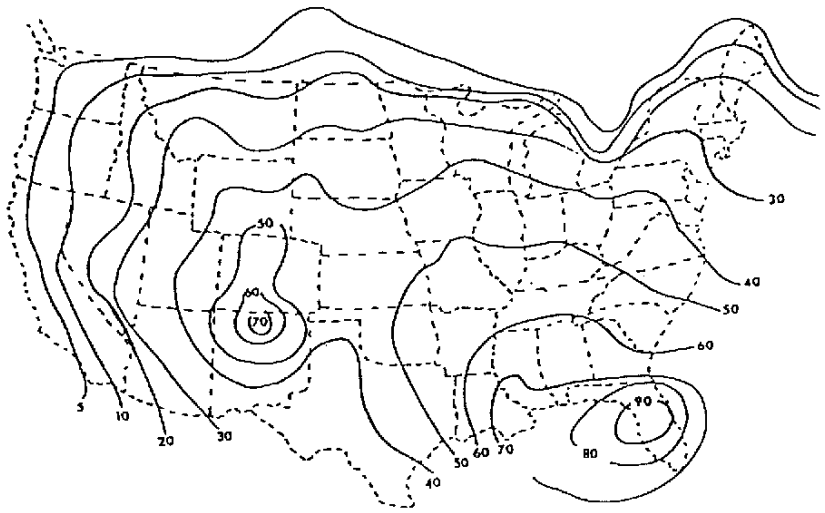

Figure b-1. Isokeraunic Map of the United States Showing Lightning Days Per Year

WARNING: Disconnect primary power prior to servicing.

In medium and short wave installations the antenna ground plane is very important as it is ½ of the radiating element. RF current leaving the antenna must return via the ground path (ground wave). For this reason the "antenna coupling unit" must be close to the base of the tower and securely connected to the ground plane.

Figure b-6 shows the basic elements of a properly designed antenna system.

- Good ground plane.
- Ball gap on tower.
- Series inductor in tower feeder.
- Antenna coupling unit connected to antenna ground.
- The π circuit is equivalent to the normal Tee used by Harris.
- Underground coax.
- Guy wire length broken by insulators and grounded at the bottom end.

The transmitter building must be given extra protection to insure reliable equipment operation. A low impedance safety ground system must be installed using 3 inch wide copper strap hard soldered at all joints and connected to multiple ground rods located at the perimeter of the building. The ground rods should be wet to make good connection to the earth water table. All equipment cabinets within the building must be connected to the ground straps for safety reasons.

b.4. AC Service Protection

See Figure b-7. All incoming ac lines should have a choke connected in series to limit the high frequency surges on the lines followed by a surge protector. The surge protector must be connected to the building ground system by short direct connections.

A surge protector is a solid state device that is a high impedance until the voltage across it reaches its rated clamping voltage at which time the impedance suddenly decreases. The protector will then conduct hundreds to thousands of amperes to ground. All protectors are rated for maximum voltage and maximum surge energy. If the surge energy exceeds rating of the device it will normally short and for this reason must be fused so it will disconnect itself from the line being protected. When this happens all protection is lost so some warning system must be used to tell the operators that a new protector should be installed.

Speed is essential to protect equipment from current surges with rates of rise exceeding 10,000 amps per microsecond and pulses that last no longer than 100 microseconds. Very short, low inductance ground straps are required to pass surges of this type.

The surge protectors must be selected for the line to ground voltage and the maximum energy to be diverted. Bigger is always better in this case. There are several manufacturers of surge protectors:

- Lightning Elimination Assoc., Inc.
- Current Technology
- Control Concept

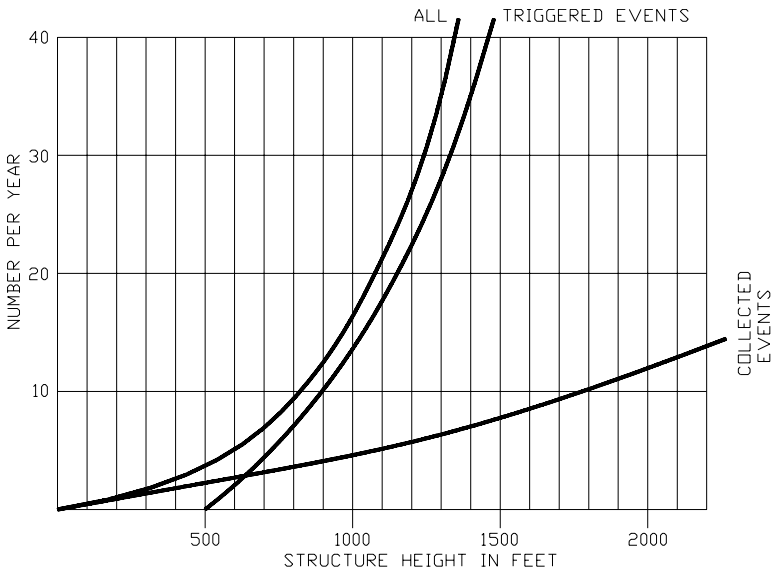

Figure b-2. Lightning Incidents to Tall Structures

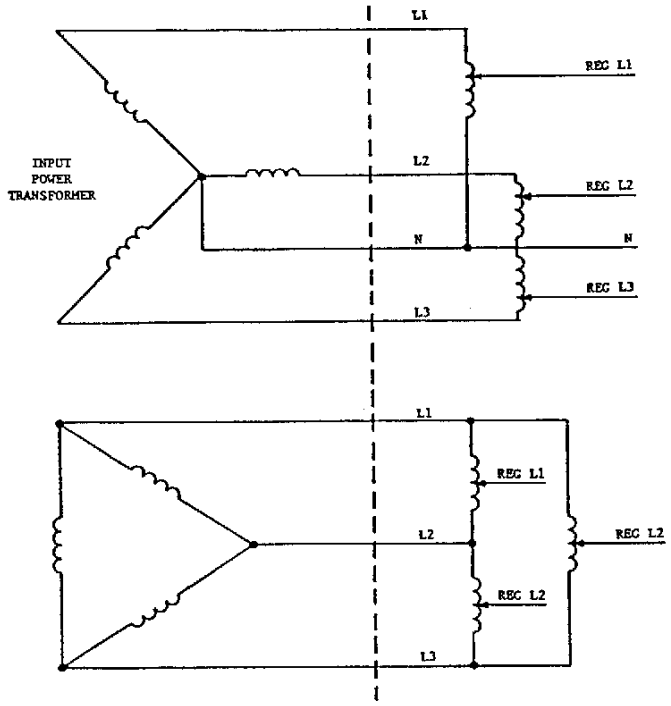

Figure b-3. Regulators in Delta and 4/Wire WYE Systems

WARNING: Disconnect primary power prior to servicing.

- MCG Electronics, Inc.
- EFI Corp.
- General Electric

All of these vendors provide parts and systems to protect broadcast transmitters.

All audio and control lines should be protected the same as described for ac lines with components sized accordingly.

All coaxial lines should have the shield connected to the system ground at the point of entrance and in addition have a ferrite choke around it located between the entrance point and the equipment rack. This will provide a high impedance for current flowing in the shield but does not affect the signal currents.

b.5. Conclusion

The 1% chance of a major lightning strike probably can not be protected against but the other 99% can be controlled and damage prevented. Install surge protection on all incoming and outgoing lines at the wall of the building connected to a well designed ground system. Properly install the antenna ground system with spark gap adjusted correctly and maintained. With this done you can sleep peacefully at night if your bed isn't under the feed line.

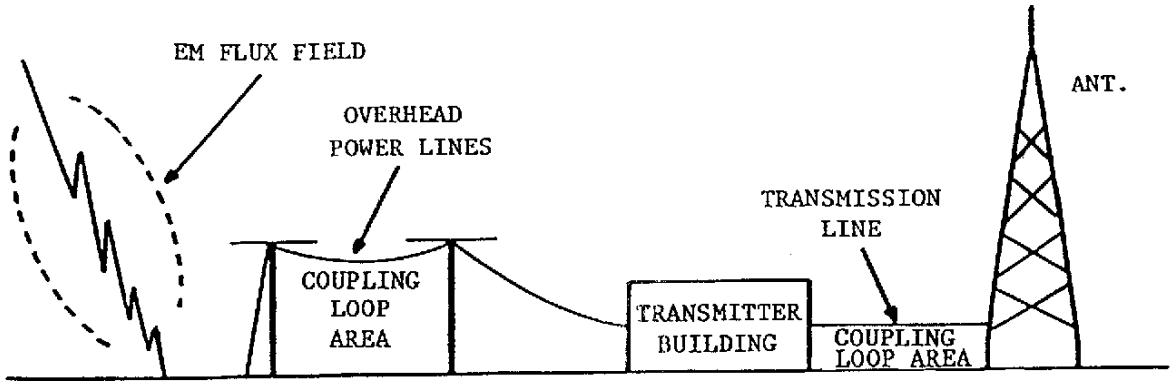

Figure b-4. EM Flux Field

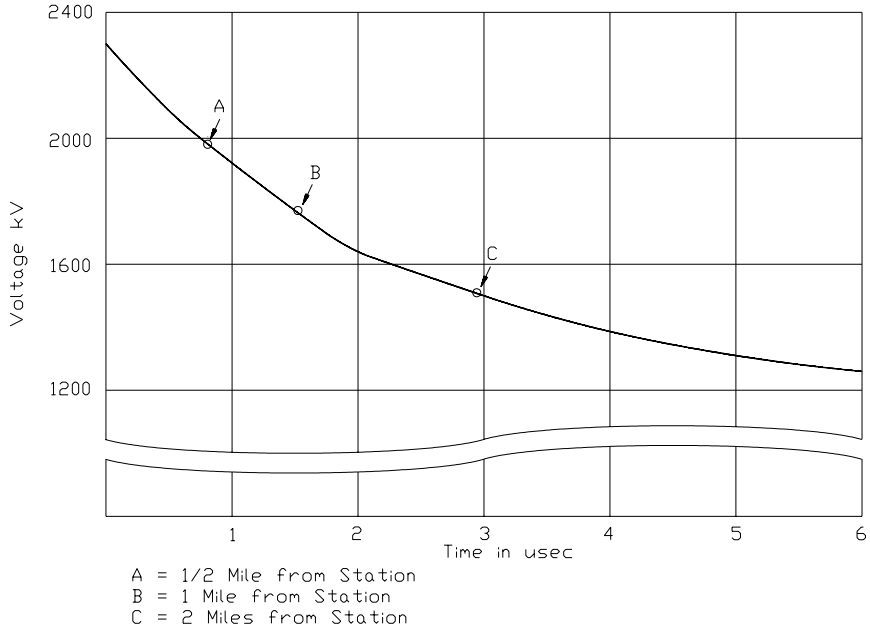

Figure b-5. Sample Surge Voltage as a Function of Distance from Stroke to Line

WARNING: Disconnect primary power prior to servicing.

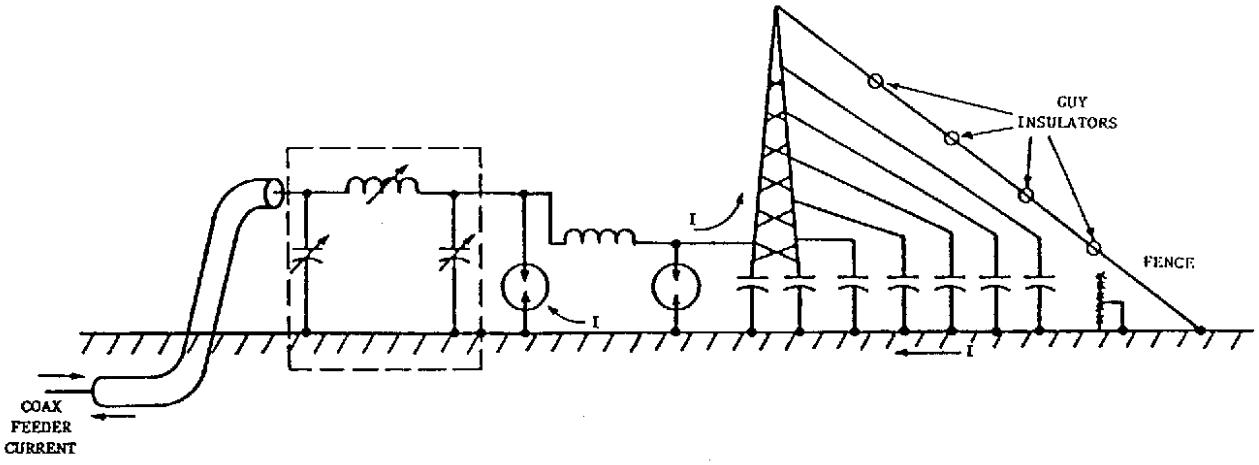

Figure b-6. Basic Elements of a Properly Designed Antenna System

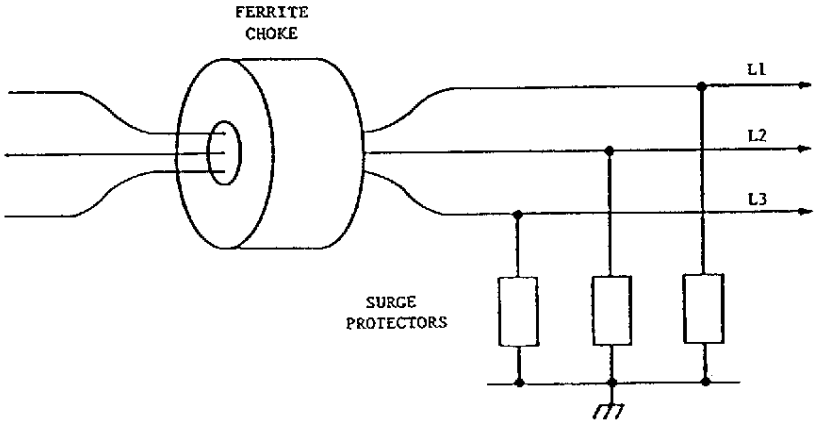

Figure b-7. Surge Protectors and Ferrite Choke

WARNING: Disconnect primary power prior to servicing.

Appendix C
Surge and Lightning Protection and Grounding Considerations

c.1 Surge and Lightning Protection

A lightning storm can cause transients in excess of 2 kV to appear on power or field signal lines. The duration of these transients varies from a few hundred nanoseconds to a few microseconds. Power distribution system transient protectors can efficiently protect the transmitter from transients of this magnitude. Transients are shunted to ground through the protection devices and do not appear on the output. To protect the transmitter from high transients on field cables, electronic surge protectors are recommended.

All lightning protection is defensive in nature, that is, reacting to a lightning strike that has already occurred; therefore, its effectiveness is limited. Nothing can provide total immunity from damage in the case of a direct lightning strike. However, surge protectors installed immediately after the main power disconnect switch in the power distribution panel will afford some protection from electrical surges induced in the power lines.

Surge protection devices are designed to operate and recover automatically. When operated within specifications, a surge protector does not require testing, adjustment, or replacement. All parts are permanently enclosed to provide maximum safety and flexibility of installation.

To assure the safety of equipment and personnel, primary power line transformers must be protected by lightning arrestors at the service entrance to the building. This will reduce the possibility that excessive voltage and current due to lightning will seek some low impedance path to ground such as the building metallic structure or an equipment cabinet. The most effective type of power line lightning protection is the one in which a spark gap is connected to each primary, secondary, and the case of the power line transformer. Each spark gap is then independently connected to earth ground. In cases where driven ground rods are used for building ground, the primary and secondary neutrals must be separated by a spark gap. If two separate ground rods are used, the rods must be at least 20 feet apart. All connections between lightning arrestors, line connections, and ground must be made as short and straight as possible, with no sharp bends.

c.2 System Grounding

Signals employed in transmitter control systems are on the order of a few microseconds in duration, which translates to frequencies in the megahertz region. They are therefore radio-frequency signals, and may be at levels less than 500 microvolts, making them susceptible to noise appearing on ground wires or adjacent wiring. Thus, all ground wiring must be low in impedance as well as low in resistance, without splices, and as direct as possible. Four basic grounds are required:

a. AC ground
b. DC ground
c. Earth ground
d. RF ground

c.2.1 Ground Wires

Ground wires should be at least as large as specified by the local electrical code. These leads must be low impedance direct runs, as short as possible without splices. In addition, ground conductors should be insulated to prevent intermittent or unwanted grounding points.

Connection to the earth ground connection must be made with copper clamps which have been chemically treated to resist corrosion. Care must be taken to prevent inadvertent grounding of system cabinets by any means other than the ground wire. Cabinets must be mounted on a support insulated from ground.

c.2.2 AC Ground

The suggested grounding method consists of two separately structured ground wires which are physically separated from each other but terminate at earth ground. The green ground wire from the AC power input must connect to the power panel and the ground straps of the equipment cabinets.

The primary electrostatic shield of the isolation transformer, if used, connects to the AC neutral wire (white) so that in the event of a transformer primary fault, fault current is returned directly to the AC source rather than through a common ground system. The AC neutral is connected to earth ground at the service entry.

Use of separate grounds prevents cross-coupling of power and signal currents as a result of any impedance that may be common to the separate systems. It is especially important in low-level systems that noise-producing and noise-sensitive circuits be isolated from each other; separating the grounding paths is one step.

Noise Grounding Plate. Where excessive high-frequency noise on the AC ground is a problem, a metal plate having an area of at least 10 square feet embedded in concrete and connected to the AC ground will assist in noise suppression. The connection to AC ground should be shorter than 5 feet, as direct as possible, and without splices. Local wiring codes will dictate the minimum wire size to be used.

Peripheral Equipment Grounds. All peripherals are supplied with a separate grounding wire or strap. All branch circuit receptacles must permit connection to this ground. This service ground must be connected through the branch circuit to a common grounding electrode by the shortest and most direct path possible. This is a safety ground connection, not a neutral.

Often, circuit common in test equipment is connected to power ground and chassis. In these cases, isolated AC power must be provided from a separate isolation transformer to avoid a ground loop.

WARNING: Disconnect primary power prior to servicing.

c.2.3 DC Ground

DC grounds in the transmitter are connected to a ground bus, which in turn is routed to a common cabinet ground and then connected to an earth ground. The use of separate ground busses is a suggested method of isolation used to prevent cross-coupling of signals. These ground buses are then routed to the cabinet ground and to earth ground.

c.2.4 Earth Ground

The transmitter must be connected to earth ground. The connection must have an impedance of 5 ohms or less. For example, a one-inch metal rod driven 20 feet into moist earth will have a resistance of approximately 20 ohms, and a large ground counterpoise buried in moist earth will exhibit a resistance on the order of 1 to 5 ohms.

The resistance of an electrode to ground is a function of soil resistivity, soil chemistry and moisture content. Typical resistivities of unprepared soil can vary from approximately 500 ohms to 50 k ohms per square centimeter.

The resistance of the earth ground should be periodically measured to ensure that the resistance remains within installation requirements.

c.2.5 RF Ground

Electrical and electronic equipment must be effectively grounded, bonded, and shielded to achieve reliable equipment operation. The facility ground system forms a direct path of low impedance of approximately 10 ohms between earth and various power and communications equipment. This effectively minimizes voltage differentials on the ground plane to below levels which will produce noise or interference to communication circuits.

The basic earth electrode subsystem consist of driven ground rods uniformly spaced around the facility, interconnected with a minimum of 1/0 AWG bare copper cable. The cable and rods should be placed approximately 40 inches (1 meter) outside the roof drip line of the structure, and the cable buried at least 20 inches (0.5 meters). The ground rods should be copper-clad steel, a minimum of eight feet (2.5 meters) in length and spaced apart not more than twice the rod length. Brazing or welding should be used for permanent connections between these items.

Where a resistance of 10 ohms cannot be obtained with the above configuration, alternate methods must be considered.

Ideally, the best building ground plane is an equipotential ground system. Such a plane exists in a building with a concrete floor if a ground grid, connected to the facility ground system at multiple points, is embedded in the floor.

The plane may be either a solid sheet or wire mesh. A mesh will act electrically as a solid sheet as long as the mesh openings are less than 1/8 wavelength at the highest frequencies of concern. When it is not feasible to install a fine mesh, copper-clad steel meshes and wires are available. Each crossover point must be brazed to ensure good electrical continuity. Equipotential planes for existing facilities may be installed at or near the ceiling above the equipment.

Each individual piece of equipment must be bonded to its rack or cabinet, or have its case or chassis bonded to the nearest point of the equipotential plane. Racks and cabinets should also be grounded to the equipotential plane with a copper strap.

RF transmission line from the antenna must be grounded at the entry point to the building with copper wire or strap equivalent to at least no. 6 AWG. Wire braid or fine-stranded wire must not be used.

All building main metallic structural members such as columns, wall frames, roof trusses, and other metal structures must be made electrically continuous and grounded to the facility ground system at multiple points. Rebar, cross over points, and vertical runs should also be made electrically continuous and grounded.

Conduit and power cable shields that enter the building must be bonded at each end to the facility ground system at each termination.

WARNING: Disconnect primary power prior to servicing.

d.1 General Description

d.1.1 Introduction

This Appendix contains the information necessary to install, operate, maintain and service the Heat Exchanger System. The parts listing for the Heat Exchanger System (Fluid Cooler, Pump Module and Kit of Interconnecting Piping, Flow Control Valves and Flow Monitoring Devices) will be found in Section 7 of the manual.

d.1.2 Equipment Purpose

The Heat Exchanger System transfers the heat generated by each tube and from each water cooled test and reject RF Loads to the atmosphere outside the building.

d.1.3 General Description

See Figure d-1. The Heat Exchanger System consists of a one stage heat transfer cooling system to cool the tube and RF Loads.

The Heat Transfer System circulates water directly in contact with the tube collector; absorbing that heat. The Heat Transfer System uses a 50% mixture of water and ethylene glycol as a coolant. This permits a liquid to air heat exchanger to be located outside the building to transfer heat from the coolant to the atmosphere without the danger of the coolant freezing

d.1.4 Major Hardware

The major pieces of hardware that make up the heat exchanger system are:

- Fluid Cooler (liquid to air heat exchanger)
- Pump Module
- Kit of Interconnecting Piping, Flow Control Valves and Flow Monitoring Devices
- Calorimeter Hardware and Digital Thermometer (for measuring transmitter power) - OPTION See Appendix E

d.1.5 Equipment Characteristics

d.1.5.1 Electrical Requirements

Table d-1 lists the electrical requirements of the Heat Exchanger System.

d.1.5.2 Mechanical/Environmental Characteristics

Table d-2 lists the physical/environmental characteristics of the major parts of the Heat Exchanger System.

NOTE

Specifications subject to change without notice.

d.1.6 Recommended Coolants

d.1.6.1 During Checkout and Flushing

Tap water may be used during initial checkout of the system and for flushing and cleaning the loop.

CAUTION

IF FREEZING CONDITIONS EXIST DURING THE CHECKOUT AND FLUSHING PROCEDURES, THE FLUSHING PROCEDURE AND SUBSEQUENT FILL WITH THE FINAL GLYCOL/WATER MUST BE FINISHED BEFORE STILL WATER IS ALLOWED TO REMAIN IN THE FLUID COOLER. IF THE PROCEDURE CANNOT BE FINISHED, CARE MUST BE TAKEN TO PREVENT THE WATER FROM FREEZING IN THE OUTSIDE FLUID COOLER. IF WATER REMAINS IN THE COOLER LONG ENOUGH TO FREEZE, THE UNIT WILL BE DAMAGED. PUMP A MIXTURE OF GLYCOL/WATER INTO THE COOLER TO PREVENT DAMAGE.

d.1.6.2 During Operation

The Cooling Loop uses a 50% mixture of deionized water and industrial grade ethylene glycol. The recommended ethylene glycol is a product of Union Carbide Company called "Ucartherm". See appendix for information on the product. Equivalent ethylene glycol from another manufacturer may be

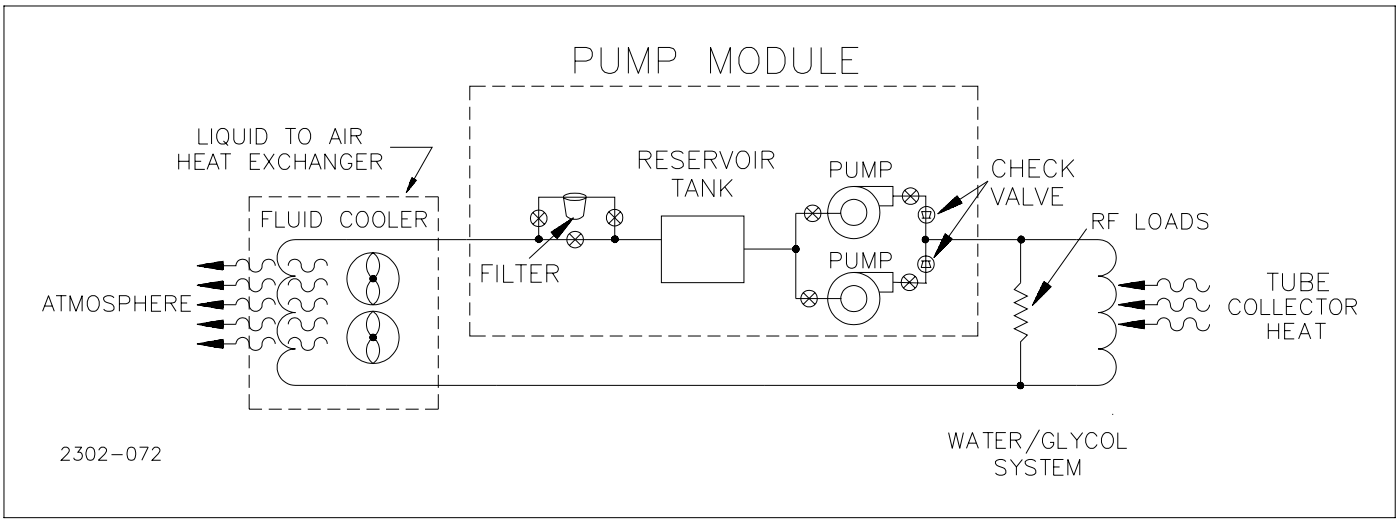

Figure d-1. Block Diagram Heat Exchanger System

WARNING: Disconnect primary power prior to servicing.

used as long as it's inhibitors are similar. Also, information on the properties of the product must be obtained from the manufacturer in order to calculate the transmitter power output calorimetrically. The information needed is the same information given in the back of this manual for Ucartherm.

CAUTION

DO NOT USE AUTOMOTIVE GRADE ANTI-FREEZE AS A SUBSTITUTION FOR INDUSTRIAL GRADE ETHYLENE GLYCOL. IT DOES NOT CONTAIN THE PROPER INHIBITORS FOR THIS APPLICATION AND WILL LEAD TO EVENTUAL DAMAGE OF THE SYSTEM.

Coolant Part Numbers	
Description	Part Numbers
Ucartherm Cooling Fluid, Hazardous Material, 55 Gal. Drum Concentrate Solution	Harris: 0511010001 Union Carbide PM6141
Ucartherm Cooling Fluid, Hazardous Material, 55 Gal. Drum 50/50 Solution	Harris: 0511010021 Union Carbide PM6171

Since the water used to mix with the glycol will affect the corrosivity of the mixture, the water used should be de-ionized water with chloride and sulfate concentrations less than 100 ppm of each substance.

d.2 Installation

d.2.1 Introduction

This section contains information for installing the Heat Exchanger System and performing preoperational checks.

d.2.2 Unpacking

Carefully unpack the Heat Exchanger System components and perform a visual inspection to determine that no apparent damage was incurred during shipment. Retain the shipping materials until it has been determined that the unit is not damaged. The contents of the shipment should be as indicated on the packing list. If the contents are incomplete or if the unit is damaged electrically or mechanically, notify the carrier and HARRIS CORPORATION, Broadcast Transmission Division.

Table d-1. Electrical Characteristics
Power Consumption

Pump Module	10 KVA Max @ 0.8 Power Factor
	460 VAC @ 60 Hz *
	380 VAC @ 50 Hz *
Fluid Cooler	
2 Fan	2 KVA Max @ 0.8 Power Factor
3 Fan	3 KVA Max @ 0.8 Power Factor
4 Fan	4 KVA Max @ 0.8 Power Factor
* Voltage & Frequency specified at time of purchase.	

Table d-2. Physical/Environmental Characteristics

Mechanical: Pump Module	
Height	65.25"
Width	36.0"
Depth	55.0"
Weight (No Coolant)	800 lbs
Glycol Coolant Tank	30 Gal./113 liters
Glycol Coolant Pressure	70 PSIG - 105 PSIG
Environmental	
Ambient Temp.	0^{o}C to +45^{o}C
Ambient Humidity Range	0 to 95% Relative Humidity
Altitude	Sea Level to 6,500 Ft. (2,000 Meters)
* Max Temp is 45^{o}C up to 1,640 ft and derates linearly to 25^{o} C at 6,360 ft.	
Mechanical: Fluid Cooler	
2 Fans, 3 Fans, 4 Fans	
Ambient Temp	115^{o}F @ sea level, Deviated 3.5^{o}F/100 ft
Ambient Humidity	0 - 95% Relative Humidity
Altitude	Sea Level to 6,500 Ft (2,000 Meters)
2 Fans	
Height	43.125"
Width	43.19"
Depth	84.0"
Weight	685 lbs
3 Fans	
Height	43.125
Width	43.19"
Depth	164.00"
Weight	886 lbs
4 Fans	
Height	3.6 Ft
Width	3.6 Ft
Depth	11.0 Ft
Weight	1340 lbs

d.2.3 Installation

Individual systems vary greatly dependent upon equipment type, power output and building layout. Only general installation recommendations will be presented. See Drawings 852-9211-100 through 400 and the main portion of this technical manual for a typical installation. If a typical system layout is not utilized,

WARNING: Disconnect primary power prior to servicing.

a consulting engineering firm should be contracted to analyze flow losses to insure the flow rates can be maintained.

d.2.4 Location

The pump module should be located in a manner which will provide access to all sides for ease of maintenance. A minimum of 36 inches clearance must be provided on all sides of the module for maintenance access.

d.2.5 Installation of Externally Mounted Fluid Cooler

The system cooling coil assembly should be located outside the building on a level concrete pad and securely fastened with anchor bolts. The cooler should be oriented so that plumbing connections to the cooler minimize plumbing elbows and complex plumbing assemblies. In addition, the cooler should be oriented so access to the fans and fan motors can be accomplished. Refer to the appropriate manufacturer's guidelines in the back of this manual.

CAUTION

THE 2 FAN FLUID COOLER'S WEIGHT IS 685 LBS. THE 4 FAN FLUID COOLER WEIGHS 1150 LBS. ENSURE THE PROPER EQUIPMENT IS AVAILABLE TO SAFELY INSTALL THE UNIT. REFER TO THE APPROPRIATE MANUFACTURER'S GUIDELINES IN THE BACK OF THIS MANUAL.

Extreme care should be exercised during the following steps to avoid equipment damage or personnel injury.

a. Lift the unit into a horizontal position using manufacturer's recommended lifting points.
b. Install the leg channels and brace angles.
c. Carefully place assembled unit onto concrete pad.
d. Fasten unit to the concrete pad.

d.2.6 Ice/Sun Shield

The fluid cooler must be protected from large pieces of falling ice. A non-air restricting structure, installed well above the cooler, that breaks up large pieces of ice before they reach the cooler is needed. Often a 2x8 or 2x10 wood planks installed vertically and spaced several inches apart have been used as an effective ice shield.

If the cooler will be exposed to strong sunlight in hot weather, the efficiency of the fluid cooler may be adversely affected. In this case, a sun shield that reduces the full effect of the sun should be considered. The ice shield covering, described above, can reduce the full effect of the sun and yet allow free movement of exhaust air from the fluid cooler.

d.2.7 Pipe Sizing and Routing

If a typical system layout is not used, the typical plumbing layout should still be consulted for pipe size information and connection details and techniques at the amplifier cabinets, RF Loads, pump module and outside fluid cooler. A custom plumbing installation must not unduly restrict flow rates or change the design of the cooling system. Locate the plumbing so that access to transmitter system components is not restricted.

Pipes must be sized no smaller than shown on the typical plumbing layout. Their routing should minimize turns and long runs. Typical flow losses for cooling circuit components are shown in Table d-3. These values can be converted to feet of water column head loss by using the following formulas:

- Head Loss (ft. H_2O)=Flow Loss (psi) X .432

d.2.8 Plumbing System Installation

The plumbing lines must be type "M" hard drawn copper with soft silver soldered joints (96.5% Tin, 3.5% Silver; Aladdin #450 silver solder or equivalent). An adequate amount of soft silver solder (Harris part 086-0004-038) is supplied with the plumbing kit. Good silver brazed joints are acceptable but not required. A poorly done brazed joint is much harder to repair than a soft silver solder joint.

d.2.9 Reserve Coolant Supply

A sufficient reserve supply of coolant should be kept on hand to refill the entire system in the event of a major leak.

d.2.10 Clean-Up Plan

A plan for containment and spill clean-up acceptable to local environmental regulations should be considered.

d.3 Operation

This section contains information pertaining to identification, location and function of the controls and indicators on the Heat Exchanger system. Table d-4 lists controls and indicators on the Pump Module. Figure d-2 (sheets 1, 2 and 3) show component location.

d.3.1 Controls and Indicators

Check the Phase Loss Monitor for an indication of proper phase presence (an illuminated LED indicates that all 3 phases of power are present **AND** in the proper phase relationship). If this LED is not illuminated, remove power from the Pump Module and swap two input phases at TB-1.

d.3.1.1 Pump Rotation

Check pumps for correct direction of rotation. The pump must operate clockwise when viewed from the motor end. The pump casing is marked with an arrow indicating correct direction of rotation.

CAUTION

PUMP MUST NOT BE OPERATED MORE THAN 5 SECONDS DRY TO CHECK ROTATION.

WARNING

DISCONNECT PRIMARY POWER AT SOURCE BEFORE INTERCHANGING WIRES.

- If rotation direction is incorrect, interchange any two of the three phase input wires at TB1-1, 2 and 3 and recheck rotation.

Table d-3. Controls and Indicators

REF.	CONTROL/INDICATOR	FUNCTION
1	FAHRENHEIT TEMPERATURE gauge	Indicates temperature of coolant to transmitter from 30°F (-1.1°C) to 220°F (104.4°C)
2	PRESSURE gauge	Indicates pressure of coolant to transmitter from 0 to 100 PSI.
3	PUMP A/OFF/B switch (S1)	Selects between a primary or secondary pump and removes pump power from pump A or pump B to enable maintenance to be performed.
4	STATUS INDICATORS (green)	
	AC POWER PRESENT	Indicates A/C power present
	CONTROL VOLTAGE PRESENT	Indicates Control voltage present
	PUMP A ON	Indicates Pump A is operating
	PUMP B ON	Indicates Pump B is operating
5	FAULT INDICATORS (RED)	
	COOLANT LEVEL LOW	Indicates a low level of coolant
	COOLANT TANK EMPTY	Indicated the coolant tank is empty
6	WARNING INDICATOR (RED)	
	ALTERNATE PUMP MODE	Indicates a remote switching of pump A/B has been done
8	FUSES	
	115V	Protects wiring for 115V power supply
	12V	Protects wiring for 12V power supply

d.3.1.2 Fan Rotation

The fans on the cooling coil should blow upwards. If a fan motor is rotating in the wrong direction, reverse two of the phases at the input to the Cooling Unit.

d.3.2 Start Up Procedure

WARNING

DUE TO THE HIGH PRESSURES INVOLVED, DO NOT OPERATE THE PUMP MODULE WITHOUT THE SIDE PANELS INSTALLED

CAUTION

UNDER NO CONDITION SHOULD THE PUMPS BE OPERATED DRY OR WITH SUCTION LINES PARTIALLY CLOSED. PUMPS MAY BE OPERATED ONLY BRIEFLY (LESS THAN 3 MINUTES) WITH DISCHARGE CLOSED. IMPELLERS, SEALS AND BEARINGS WILL BE DAMAGED IF PUMPS ARE OPERATED IMPROPERLY.

Table d-4. System Coolant Capacities

System Type	Coolant Capacity (gallons)	Coolant Capacity (liters)
1 Tube	60	227.1
2 Tube	80	302.8
3 Tube	100	378.5
4 Tube	160	605.6

d.3.3 Glycol Cooling System

For initial cooling system flush or cleanout of an existing system, proceed to steps l. through r., using tap water.

a. Close pump B service valves on suction and discharge sides.

b. Open pump A service valves on suction and discharge sides.

c. Depending on system plumbing layout, open any valves external to the pump module so that air can vent during system fill, also any flow control valves to transmitter and load.

d. Fill the system with tap water. Pump module tank capacity is 30 gallons (113.55 liters). Capacity will vary with individual system size and layout. Refer to Table d-4 for systems capacities. Check the system and repair any leaks.

NOTE

The system cannot be filled to capacity at this time. Water must be added as pipes and equipment complete fill up at initial pump turn on. The reservoir tank is equipped with a level switch which will shut the pump off if a low water level occurs.

e. Close all flow control valves in the transmitter system.

WARNING

ENSURE PRIMARY POWER IS OFF BEFORE JUMPER IS INSTALLED IN STEP f.

f. Install a jumper wire across terminals 1 to 10 of TB2 to allow pump turn on independent of transmitter. Turn on primary power.

g. Set S1 to OFF prior to applying pump power.

h. Jog the toggle switch from OFF to A to check and verify direction of rotation. If the direction is wrong see paragraph D.3.1, if correct proceed to step i.

i. Allow pump to operate for approximately 30 seconds. At this time, the pressure gauge should rise to 70 to 90 psi. If pressure does not rise, shut off pump and vent air from pump casing by removing seal flushing fitting at top of pump casing. Replace fitting after air vents.

CAUTION

PUMPS THAT ARE USED IN THE HEAT EXCHANGER WILL DELIVER TO THE POINT WHERE MOTOR OVERLOAD OCCURS. IN NO CASE SHOULD THE FLOW REQUIRED FROM A SINGLE PUMP EXCEED 100 GPM. ON PARALLEL UNITS, FLOW MUST NOT EXCEED THE NUMBER OF PUMPS TIMES 100 GPM OR 100 GPM PER PUMP.

j. When the pump operates within 70 to 90 PSI, the flow control valves to the transmitter are adjusted to the correct

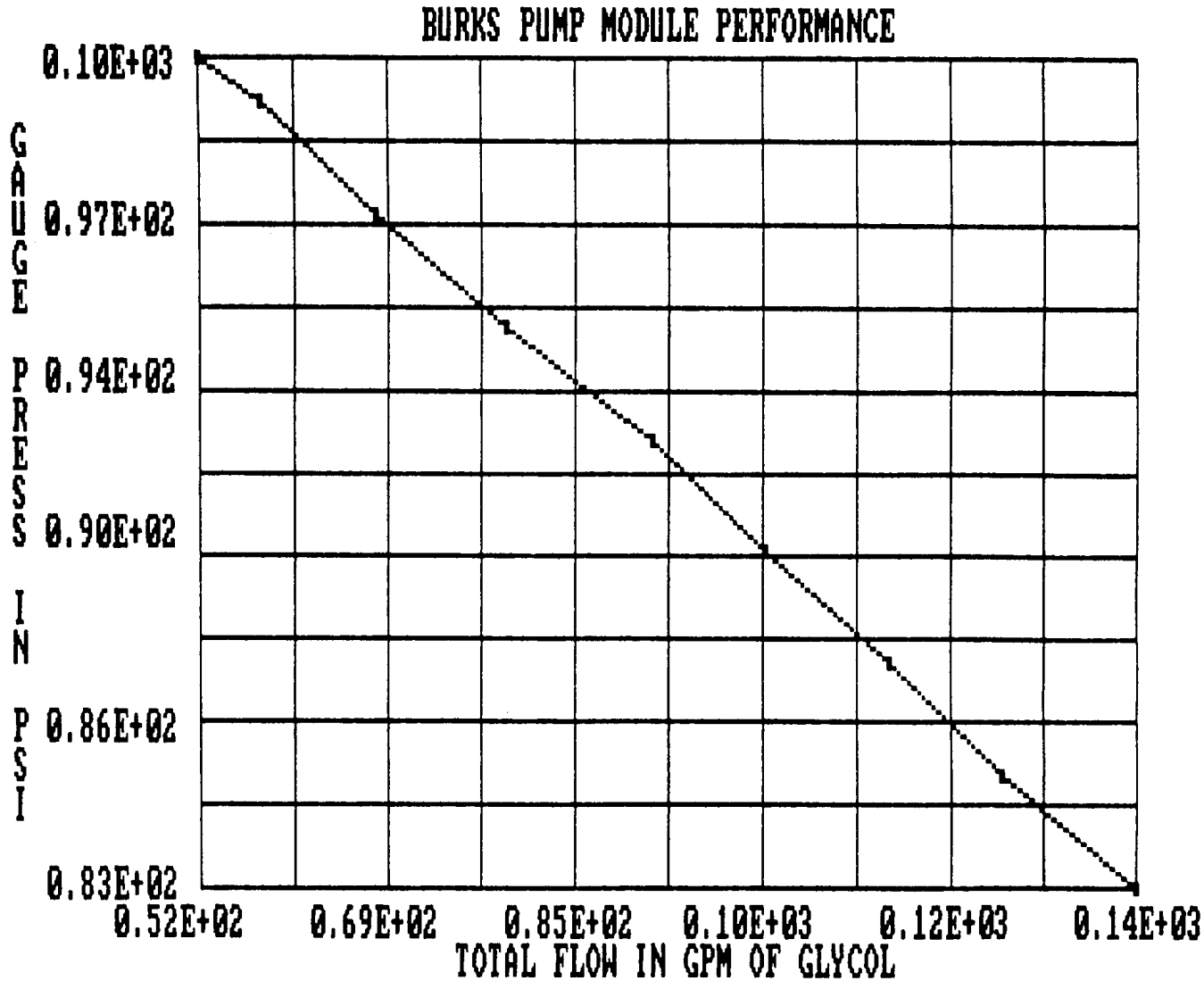

Figure d-2. Pump Performance Parameters

WARNING: Disconnect primary power prior to servicing.

flow rates. Refer to the schematic package OVERALL TRANSMITTER COOLING FLOW DIAGRAM:

CD 50 P1	839-8201-100
CD 100 P2	839-8201-200
CD 150 P3	839-8201-300
CD 200 P4	839-8201-400

k. In a 2 pump system, open service valves (suction and discharge) to pump B, set S1 to B position and repeat steps i. and j.

l. On the rear of the pump module locate the Teel scrubbing filter. Ensure a filter cartridge has been installed. (The filter is utilized for initial system cleaning only. A flow of 12 gpm is available through the filter.)

m. Locate the tank return isolation gate valve. Close the tank return valve and open the two 3/4 inch gate valves which will allow coolant system flow to be routed through the filter cartridge. After the initial flush the filter should be bypassed and the coolant return gate valve should be fully opened.

n. After the pump module and water circuit have been tested and flows are correctly adjusted **per the transmitter cooling section,** open all output, inlet and balance valves. Allow water to circulate 30 minutes with the pump operating.

o. Shut off the pumps. Drain tap water from the system and clean any strainers installed in the system.

p. Repeat flushes until cooling fluid appears to be clean.

q. For systems which are excessively dirty, flush using a mixture of 4 cups of a non-sudsing detergent (such as Cascade) in 2 gallons of water. Strain mixture into tank through a fine filter. Fill tank with hot tap water. Operate pumps for 30 minutes, drain the system and reflush with clean tap water.

r. Refill the system with a 50% glycol/water mixture. Refer to Appendix E for mixture concentrations.

WARNING

ENSURE PRIMARY POWER IS OFF BEFORE JUMPER IS REMOVED IN STEP t.

s. Shut off primary power and remove jumper wire installed in step f.

t. Turn on primary power. Set pump switch (S1) to OFF. The heat exchanger system is now operational.

d.3.4 Pump Performance Parameter.

Correct operation of the pump module can be verified by reading the pump module pressure gauge and referring to Figure d-2. Reading the gauge pressure horizontally across to the pump discharge curve and down to the flow rate axis will give the actual system flow rate. If the flow rate is grossly different than expected, the system plumbing is not performing as expected. The reason should be located and corrected.

Table d-5. Cooling System Scheduled Maintenance

CHECK	FREQUENCY	RESULTS/NOTES
Glycol basket strainers	30 hours 1st week; then monthly	Note any unusual contents.
Clean RF Load(s) particle filter(s)	30 hours 1st week; then semi-annually	Note any unusual contents.
Check pump pressures	Weekly	Approximately 90 PSI. Compare with previous readings
Check plumbing system and tubes for leaks	Weekly	Repair leaks around tubes immediately.
Check water and glycol reservoir levels	Weekly	Compare with previous reservoir levels.
Check fluid cooler fan operation	Monthly	Use fan test buttons. Check for unusual noises. Make sure fans are tight on motor shafts.
Check pumps for excess noise and seal leaks	Monthly	Check for unusual noises. Look for leakage around pump shaft.
Check alternate pump operation	Monthly	Check pressures; quiet operation. Check for seal leaks.
Clean dirt from fluid cooler coils; fans	Semi-annually	Use air conditioner cleaning solution and high pressure hose.
Check condition of glycol solution	Annually	Use hydrometer to check freezing point. Check clarity of the solution. Be aware of increased granular particles in filters.
Lubricate glycol pump (Do not over lubricate)	Annually	Use Chevron SR1 grease (1/2 oz tube available from Burks Pumps; order #9199)

d.4 Description of Operation

d.4.1 Temperature Control

Temperature control of the transmitter is accomplished by pumping a water/glycol fluid from the pump(s) through the tube collector and the RF Load(s), where the fluid absorbs heat. The coolant is then directed to the External Fluid Cooler. The output temperature of the fluid after it has gone through the cooler is used as a reference temperature. If the temperature of the outlet coolant is less than 90°F, no fans are running. When the temperature reaches 90°F half the fans activate. Should the outlet coolant temperature rise above 100°F the remaining fans will activate.

This 3 speed cooling will keep the coolant temperature in the normal operating range of 90 to 100°F.

Table d-6. Pump Troubleshooting

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
PRESSURE ERRATIC, SOUNDS LIKE PUMPING GRAVEL (CAVITATION)	Clogged suction line	Clear suction line
	Closed discharge valve	Open discharge valve
	Check valve on pump discharge stuck closed	Replace check valve
	System flow rate too high; pressure too low	Raise system pressure by adding fluid, adjusting system valves; check for leaks.
	System filter screens clogged	Clean screens.
PUMP LEAKS	Seal broken or worn	Replace seal
	Casing gasket broken	Replace gasket
PUMP LOCKED - DOES NOT TURN	Bearings frozen	Replace pump, motor or bearings
	Foreign object lodged in impeller casing	Disassemble pump and remove object - replace damaged parts
PUMP SHUTS OFF	Low coolant level	Add Water/glycol
	Incorrect heaters in overload protectors	Replace heaters with correct units
	Motor overloaded (Flow too high)	Reduce flow
		Set flow control valves correctly
	Blown fuse	
PRESSURE BELOW SPECIFICATION	Worn impeller or casing rings	Replace impeller or casing rings.
	Flow too high.	Reduce flow

Table d-7. Fan Troubleshooting

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
EXCESSIVE VIBRATION OR NOISE	Damaged fan	Replace fan
	Loose or broken motor mount	Tighten or repair/replace
	Motor rain shield loose or damaged	Tighten or replace
	Fan safety guards loose or damaged	Tighten, repair or replace
FAN WON'T RUN	Blown Fuse	Replace fuse
	One or more power input phases low or not present	Check indicator on phase loss monitor. Check power line voltage. Reverse any two of 3 phase input wires.
FAN WON'T RUN WHEN COOLANT IS HOT OR FAN SHUTS OFF TOO SOON	Motor overloaded	Check for free rotation
	Thermostat set wrong or is defective	Check thermostat
	Thermostat sensor monitoring air temperature rather than coolant temperature.	If sensor is the type that measures temperature on outside of pipe, make sure the sensor is tightly pressed against the pipe with straps and/or thermally insulated tape.
LOW AIR FLOW	Restricted inlet. (Bottom of cooler).	Remove restriction
	Clogged coil fins	Clean coils
	Fan loose on motor shaft	Tighten

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d.4.2 External Fluid Cooler

The fluid cooler is a weatherproof unit designed to be mounted outdoors. The unit is equipped with finned coils through which the hot coolant passes. The finned coils transfer heat from the hot coolant to the air. Cool air is drawn from the bottom of the cooler by fans mounted above the coils, through the coils, and is exhausted from the top of the cooler.

The fans, driven directly from the motor shafts, are cycled on as a function of the liquid temperature leaving the cooler. Temperature sensors, attached to the coil outlet header, operate thermostats that energize half of the fans when the coolant temperature reaches 90^{o}F. If the ambient temperature is particularly warm, the operation of only half the available fans may be insufficient to properly cool the fluid. In this case, when the coolant temperature reaches 100^{o}F, the remaining fan(s) energize providing the needed air flow. The fluid cooler supplied with the transmitter has been chosen to provide sufficient transmitter cooling under worst case ambient and heat load conditions.

Because the fans operate strictly as a function of exiting fluid temperature, during cold weather the fans may not run at all.

d.4.3 Coolant System

d.5 Maintenance

d.5.1 Preventative Maintenance

The following information is intended to provide guidelines in establishing a regular maintenance program that will minimize downtime. Preventative maintenance should be performed as shown in Table d-5.

d.6 Troubleshooting

Troubleshooting is separated into pump troubleshooting (Table d-6), fan troubleshooting (Table d-7), and thermal problems (Table d-8). Refer by symptom to the applicable table and follow the corrective action indicated.

Prior to starting a troubleshooting procedure check all switches, power cord connections, connecting cables and power fuses.

Table d-8. Thermal Troubleshooting

TROUBLE SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
COOLANT OVERHEATS	Fluid cooler coil fins dirty	Clean coils with industrial air conditioner cleaner and high pressure spray
	Fluid cooler fans not running	Troubleshoot fan operation

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Table d-9. IOT Fluid Cooler 60Hz - 2, 3, 4, Fan Units

Harris P/N	Description	QTY/UM	REF. SYMBOLS/EXPLANATIONS
570 0357 000	Contactor	2	K1, K2
430 0246 000	Fan Motor	2	FA1, FA2
472 1758 000	Control Transformer	1	T1
430 0244 000	Fan Blade	2	N/A
430 0245 000	Fan Guard	2	N/A
442 0137 000	Thermostat -30^{o}F to +90^{o}F		
442 0130 000	Thermostat +55^{o}F to +175^{o}F		

Table d-10. IOT Fluid Cooler 50Hz - 2, 3, 4, Fan Units

Harris P/N	Description	QTY/UM	REF. SYMBOLS/EXPLANATIONS
570 0356 000	Contactor	2	K1, K2
430 0243 000	Fan Motor	2	FA1, FA2
472 1759 000	Control Transformer	1	T1
430 0244 000	Fan Blade	2	N/A
430 0245 000	Fan Guard	2	N/A
442 0137 000	Thermostat -30^{o}F to +90^{o}F		
442 0130 000	Thermostat +55^{o}F to +175^{o}F		

WARNING: Disconnect primary power prior to servicing.

WARNING: Disconnect primary power prior to servicing.

Appendix E
Calorimetric Measurement (OPTION)

e.1 General Introduction

The power output of a transmitter can be accurately verified by calorimetric measurement of the coolant passing through a reject load. The calculation of this power can be made by using the following formula.

$$Q = 146.54 \times \frac{IndicatedFlowRate}{\sqrt{\frac{7.02 \times S.G._F}{8.02 - S.G._F}}} \times S.G._F \times C_p \times \Delta T$$

Where

Q	=	Power in Watts
Indicated Flow Rate	=	Visually indicated flow in the flow meter in GPM
$S.G._F$	=	Specific Gravity of the coolant at the flow meter temperature
C_p	=	Specific heat of the coolant passing through the load
ΔT	=	Temperature rise of the coolant across the load in ^oF

Errors in measurement of the flow, ΔT and S.G. can cause dramatic changes in the calculated result. Therefore, the more accurate the measurement, the more consistent the result.

To minimize these errors, run the transmitter power under evaluation into the load for an extended period to allow the system to become thermally stable. When temperature measurements across the load seem to vary, take several readings over time and average them before applying them to the formula.

The same averaging technique should be applied to reading the flow measurement if it varies during the data taking period.

The formula given alone holds true for both water calculations and for ethylene-glycol mixtures. The various correction factors have been added to compensate for both the water specific gravity changes due to temperature changes as well as the glycol mixtures.

e.2 Measuring the Temperature

The steps required to perform the data gathering process will be explained in the following example. In order to perform the calculation, you must measure flow, the temperature into the load, and the temperature out of the load. Proper calorimetric setup is shown in Figure e-1. Once the data has been gathered, you will have the following formula entries.

Indicated flow - An average reading in GPM over the test period

ΔT = An average temperature rise across the reject load in ^oF

T_{Ave} = The average temperature of the coolant passing through the reject load in ^oF ($T_{ave} = \frac{AveT_{out} - AveT_{in}}{2}$)

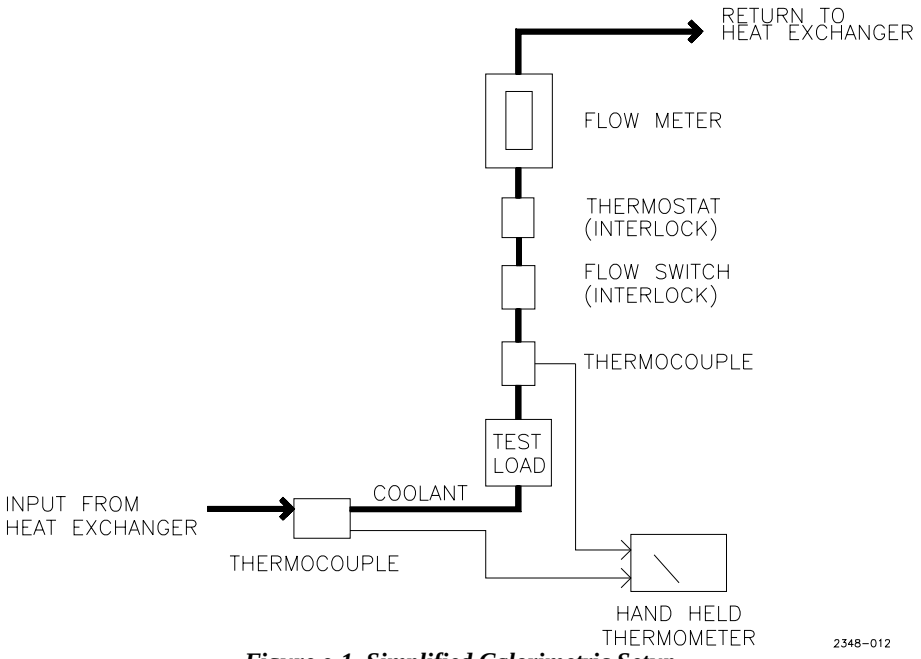

Figure e-1. Simplified Calorimetric Setup

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e.3 Specific Gravity

The next step is to determine the coolant specific gravity. This is accomplished by using the hydrometer and cylinder supplied with the installation.

Extract a sample of the coolant being used and cool it to 60°F (Note: this is the temperature to which your hydrometer has been calibrated.)

Read the specific gravity as accurately as possible. With this number we can determine the concentration or per cent of glycol in the solution. Let us assume the S.G. reads 1.060 on the hydrometer scale.

Refer to Figure e-2 at the 60°F curve (interpolation will be required). Reading across the 1.06 S.G. line to the intersection of the 60°F curve (Point A) and then vertically down to the % of UCARTHEM in the solution, shows that this particular sample is a 40% glycol mixture.

Now we are ready to fill in the formula based on our data gathered. Assume our data reads as follows:

S.G. at 60°F = 1.060

Ave Temp into the load = 120°F

Ave Temp out of the load = 180°F

The Ave indicated flow on the flow meter = 10 GPM

$\Delta T = 180 - 120 = 60^oF$

$T_{Ave}=\frac{180+120}{2}=150^oF_{Ave}$ through the load

Temperature of the coolant at the flow meter = 120°F (the same as the temperature into the load.)

$$Q=146.54\times\frac{Indicated Flow\ o 10 GPM}{\sqrt{\frac{7.02\times S.G._F}{8.02-S.G._F}}}\times S.G._L\times C_p\times\Delta T$$

We need to now find $S.G._F$ or specific gravity of the 40% glycol at the flow meter temperature.

Again refer to Figure e-2. From the bottom scale and 40% solution, run vertically until the fluid temperature curve you desire crosses the 40% solution line. In our case, the temperature at the flow measure is 120°F (Point B). Now read across to the left and this will be the S.G. for the fluid at the flow meter. In our case,
$S.G._F = 1.046$.

Table e-1. Specific Gravity and Density of Water at Atmospheric Pressure (Weights are in vacuo)

Temp. deg C	Specific gravity	Density lb per cu ft	Temp. deg C	Specific gravity	Density lb per cu ft
0	0.99987	62.4183	40	0.99224	61.9428
2	0.99997	62.4246	42	0.99147	61.894
4	1.00000	62.4266	44	0.99066	61.844
6	0.99997	62.4246	46	0.98982	61.791
8	0.99988	62.4189	48	0.98896	61.737
10	0.99973	62.4096	50	0.98807	61.682
12	0.99952	62.3969	52	0.98715	61.624
14	0.99927	62.3811	54	0.98621	61.566
16	0.99897	62.3623	56	0.98524	61.505
18	0.99862	62.3407	58	0.98425	61.443
20	0.99823	62.3164	60	0.98324	61.380
22	0.99780	62.2894	62	0.98220	61.315
24	0.99732	62.2598	64	0.98113	61.249
26	0.99681	62.2278	66	0.98005	61.181
28	0.99626	62.1934	68	0.97894	61.112
30	0.99567	62.1568	70	0.97781	61.041
32	0.99505	62.1179	72	0.97666	60.970
34	0.99440	62.0770	74	0.97548	60.896
36	0.99371	62.0341	76	0.97428	60.821
38	0.99299	61.9893	78	0.97307	60.745

Table e-2. Specific Heat of Water at 1 Atm (I.C.T)

Temperature in degrees F.	32	50	100	150	212
C_p	1.001	1.002	1.004	1.009	1.021

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This step is required to correct the indicated flow reading at the meter into the actual flow being measured. This is due to the flow meter being calibrated to a S.G. of 1.0.

Next, we must determine the Ave specific gravity flowing through the reject load ($S.G._L$). This is found in the same manner, except the fluid temperature is now the average temperature passing through the load, which in our case is 150°F.

S.G.L = 1.037 (Point C)

The next task is to determine C_p or specific heat of the fluid flowing through the load.

- T_{Ave} = 150°F

Since the chart is in °C we must convert

- °C = 5/9 (°F - 32)
- °C = 65.55

From the base of the chart at 65.55°C, run vertically until the 40% solution line crosses the 65.55°C line (Point A). Read to the left to locate the value for C_p.

- In our case it is Cp = .92

Now all the data has been gathered.

The calculation of the power dissipated in the load becomes:

$$Q=146.54\times\frac{IndicatedFlowof10GPM}{\sqrt{\frac{7.02\times S.G._F}{8.02-S.G._F}}}\times1.037\times.92\times60$$

Q = 81,748.651 Watts being dissipated into load with a 40% glycol solution.

NOTE

*The specific heat and specific gravity of water is **NOT** always equal to 1.0.*

Refer to Figure e-2. This chart will simplify calculations and convert the formula as shown below.

$$Q=146.54\times\frac{IndicatedFlowRate}{CorrectionFactor}\times S.G._F\times C_p\times\Delta T$$

Read the specific gravity on the left and the correction factor on the bottom.

The flow meter and the thermometer wells may be positioned at a convenient eye level location for ease in reading. There is no major reason to locate them extremely close to the load connections to insure temperature accuracy. Calculation can be made to show that the temperature change in the fluid, due to thermal loss from bare pipes, is so small that it can be reasonably ignored. For example, at a flow of 10GPM the temperature change due to thermal losses in bare 1 inch pipe are on the order of 1°F per 100 feet of pipe. The closer to the load, the more accurate the measurement (assuming uninsulated pipe). Reasonable location selection and insulated lines should be considered, depending upon plant layout.

e.4 Transmitter Operation

Assuming that materials in the cooling system are compatible and that the pumps allow for the additional heat loss due to glycol, only the change in specific heat affects transmitter operation. When cooling with solutions of ethylene glycol of approximately 50% concentration, actual flow rate should be increased 15%. This corresponds directly to the decrease in heat capacity.

e.5 Heat Transfer Solutions

e.5.1 Ethylene Glycol

Commercial Grade "Ucartherm" (Union Carbide Corporation) Ethylene Oxide/Glycol is the recommended heat transfer fluid to be used for the liquid portion of the cooling system.

Automotive grade antifreeze is not recommended due to the silicon additives which can cause incompatibility problems with pump seals and other components within a system.

Due to a tendency of the glycol to break down over time when mixed with chlorinated water, it is recommended that deionized water or distilled water be used for the solution.

The life expectancy of a "Ucartherm" system can be as long as 10-15 years for a clean system installed and monitored per the recommended procedures.

Glycols are excellent penetrants. Systems tested with water and checked to be tight sometimes will leak when glycol solutions are then added. Recheck the system for leaks after installing the glycol mixture.

Distribution information may be obtained by contacting Union Carbide Corporation (312-454-2162).

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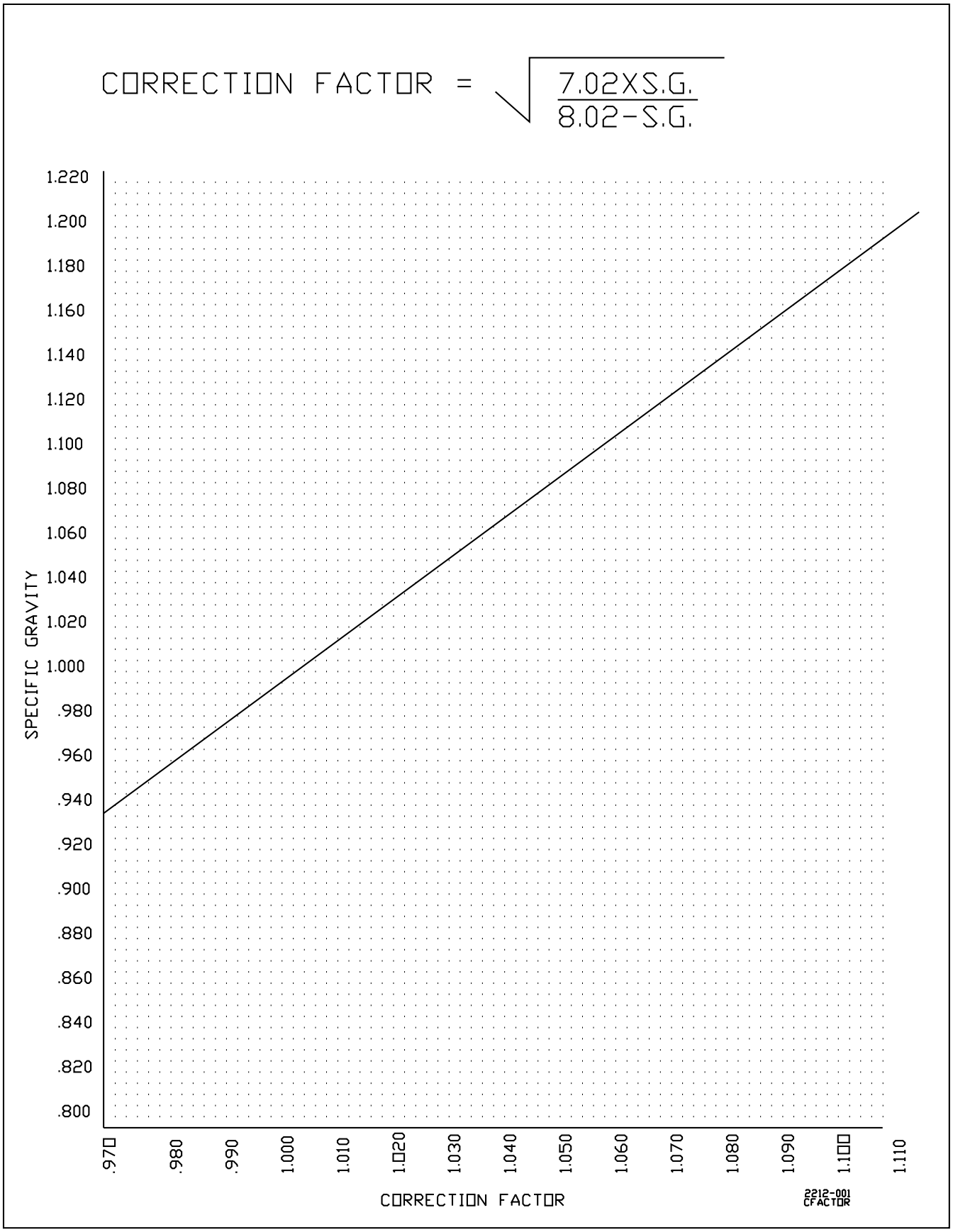

Figure e-2. Correction Factor

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Operating Practices

System Preparation

Certain necessary precautions should be taken in order to realize the long-term trouble-free operation that UCARTHERM Heat Transfer Fluid has been designed to provide. Field results have shown that inorganic chlorides are an extremely corrosive species towards carbon steel, and that fluids operating above 300° F in the presence of air are subject to a more rapid oxidative attack than at lower temperatures. Similarly, the presence of sludge or scale-type materials disrupts the sensitivity of controls, fouls valves, and impairs the heat transfer characteristics of the system. When the service life of a heat transfer fluid is considered complete, the system must be thoroughly cleaned before introducing a fresh charge. All scale, rust, sediment, and residual chlorides must be removed. Such a thorough cleaning of the system will prolong the service life of the replacement fluid and insure satisfactory operating conditions. The services of a professional chemical cleaner to prepare the system should be considered.

Solution Preparation

Dilute concentrated UCARTHERM Heat Transfer Fluid to desired freezing point concentration (see Figure 1 and Table 3), using distilled or deionized water, or water containing less than 100 ppm $CaCO_3$ hardness (less than 40 ppm Ca and Mg) and containing less than 100 ppm chloride and/or sulfate ions. UCARTHERM Heat Transfer Fluid is also available in a wide range of deionized water mixtures, thereby eliminating your having to mix to the desired concentration.

Minimum Concentration

To provide adequate corrosion protection, the minimum aqueous concentration of UCARTHERM Heat Transfer Fluid should be 25 percent. Monitor the concentration, by either specific gravity or refractive index measurements or, indirectly, by Karl Fischer titration.

Maximum Use Temperatures

Maximum bulk fluid temperature with a high degree of aeration . . . . . 80° C (176° F)
Maximum bulk fluid temperature with vent or breather line as source of air . . . . . 120° C (248° F)
Maximum bulk fluid temperature, closed . . . . . 135° C (275° F)
Maximum skin temperature on UCARTHERM Heat Transfer Fluid side of heat exchanger . . . . . 160° C (320° F)

Union Carbide offers a wide range of other heat transfer fluids that are suitable for use above 275° F. (Refer to our UCON® Fluid and Lubricants Booklet (F-6500-0)).

Filter

Use cotton or cellulosic-type non-adsorbent filter. By pass filters are preferred to minimize pressure drop.

Construction Material Compatibility

UCARTHERM Heat Transfer Fluid contains corrosion inhibitors to protect cast iron, steel, aluminum, copper, copper alloys, and solder. It is not recommended for use with galvanized steel. It is compatible with polyethylene, polypropylene, and elastomers and seals used for high temperature water service.

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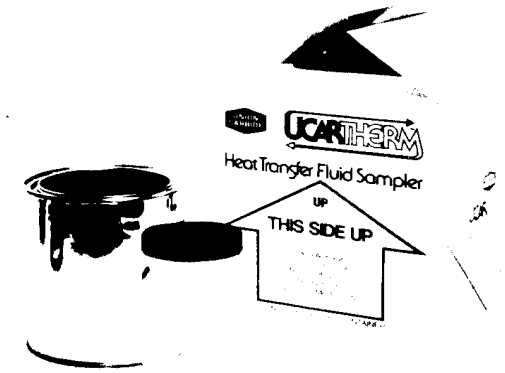
How to Maintain the Performance of Aqueous Solutions of UCARTHERM™ Heat Transfer Fluid

Having chosen a reliable source of supply, the next most important step is to maintain efficient inhibitor levels and the proper freezing point. Within 12 to 24 hours after an initial fill of UCARTHERM Heat Transfer Fluid, we will test your fluid. We suggest a recheck at six months, another at a year and once a year thereafter. For older systems with capacities over 500 gallons, sampling should be done once a year.

FREE ANALYSIS

Union Carbide assists you in optimizing your system with a free sample analysis. All you do is circulate the system for thirty (30) minutes, draw off a sample of the solution into the one-pint bottle in our UCARTHERM Heat Transfer Fluid Sampler, fill out the questionnaire in the box, label and return it to our South Charleston Technical Center in the shipping container provided.

You will shortly receive a computer printout of the analysis including percent of UCARTHERM in solution, freezing point, pH, reserve alkalinity, concentration of inhibitors, appearance, amount of UCARTHERM and/or inhibitor needed to stablize your system and recommendations on how to run your system efficiently.



If you prefer to perform your own analyses, we will provide proper procedures on request.

How to Adjust System for Freezing Protection

Freezing protection relates to concentration of UCARTHERM Heat Transfer Fluid. If the concentration is not known, it may be determined by refractive index, specific gravity or, indirectly, by Karl Fischer titration. Determination by specific gravity is convenient, reliable, and widely used. For those with the appropriate facilities or equipment, determination by Karl Fisher titration or measurement by refractive index may be preferred. In all procedures, contamination will introduce errors.

American Optical's hand-held refractometer (Model 7181 Duo Chek Battery and Coolant Tester) is suited to field monitoring of diluted UCARTHERM Heat Transfer Fluid. This refractometer is temperature compensated and reads directly in freezing point of the mixture.

The following formula can be used to determine the amount of coolant to drain and the amount (in gallons) of UCARTHERM to add when adjusting to the desired UCARTHERM concentration:

$$\text{Quantity of UCARTHERM to be added (gallons)}^{*} = \frac{\text{Gallon capacity of System [Volume \% Desired} - \text{Volume \% Currently in System]}}{100 - \text{Volume \% Currently in System}}$$

*The same number of gallons must also be drained.

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Figure 1 • Freezing Points of UCARTHERM Heat Transfer Flui

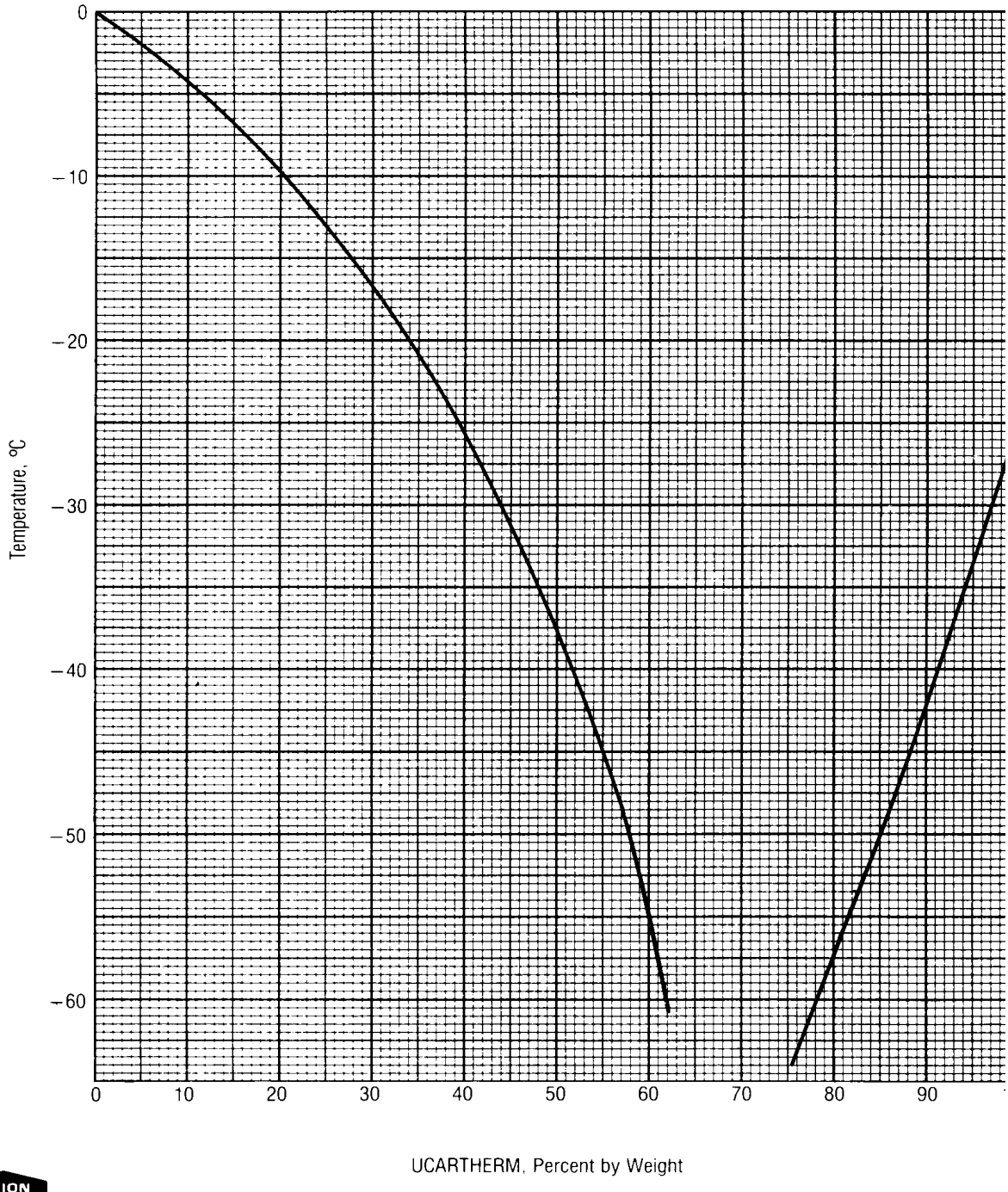

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Table 1

Typical Physical Properties of Aqueous Solutions of UCARTHERM™ Heat Transfer Fluid

Per Cent, by Volume	Per Cent, by Weight	Freezing Point, °F	Boiling Point, °F	Specific Gravity, 60/60°F	Specific Gravity, 80/60°F	Refractive Index, n_D 77°F (25°C)
25	27.4	5.5	217	1.043	1.039	1.3591
26	28.5	3.9		1.044	1.041	1.3601
27	29.5	2.5		1.046	1.042	1.3612
28	30.6	1.4		1.047	1.044	1.3623
29	31.6	−0.4	218	1.049	1.045	1.3633
30	32.7	−1.8		1.050	1.047	1.3644
31	33.7	−3.6		1.052	1.048	1.3654
32	34.8	−4.7		1.054	1.050	1.3665
33	35.8	−6.7	219	1.055	1.052	1.3675
34	36.8	−8.5		1.057	1.053	1.3686
35	37.9	−10.1		1.058	1.055	1.3696
36	38.9	−12.1	220	1.060	1.056	1.3707
37	39.9	−13.7		1.061	1.057	1.3717
38	41.0	−15.7	221	1.063	1.059	1.3728
39	42.0	−17.9		1.064	1.060	1.3738
40	43.0	−19.8		1.066	1.062	1.3748
41	44.0	−21.8	222	1.067	1.063	1.3758
42	45.1	−23.8		1.069	1.064	1.3768
43	46.1	−26.3		1.070	1.066	1.3779
44	47.1	−28.7	223	1.072	1.067	1.3789
45	48.1	−31.0		1.073	1.069	1.3799
46	49.1	−33.3	224	1.075	1.070	1.3809
47	50.1	−35.7		1.076	1.071	1.3819
48	51.1	−37.8	225	1.078	1.073	1.3830
49	52.1	−40.4		1.079	1.074	1.3840
50	53.1	−43.2	226	1.081	1.076	1.3850
51	54.1	−46.5		1.082	1.077	1.3860
52	55.1	−49.4	227	1.084	1.078	1.3870
53	56.1	−52.2		1.085	1.080	1.3881
54	57.1	−55.7	228	1.087	1.081	1.3891
55	58.1	−59.8		1.088	1.082	1.3901
56	59.0	−63.4		1.089	1.084	1.3911
57	60.0	−67.2	230	1.091	1.085	1.3921
58	61.0	−72.4		1.092	1.086	1.3931
59	62.0	−76.0		1.094	1.088	1.3942
60	62.9	−81.4	232	1.095	1.089	1.3952

NOTE: Additional engineering data is available from Union Carbide sales offices.

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Figure 2 • Specific Gravity of UCARTHERM Heat Transfer Fluid

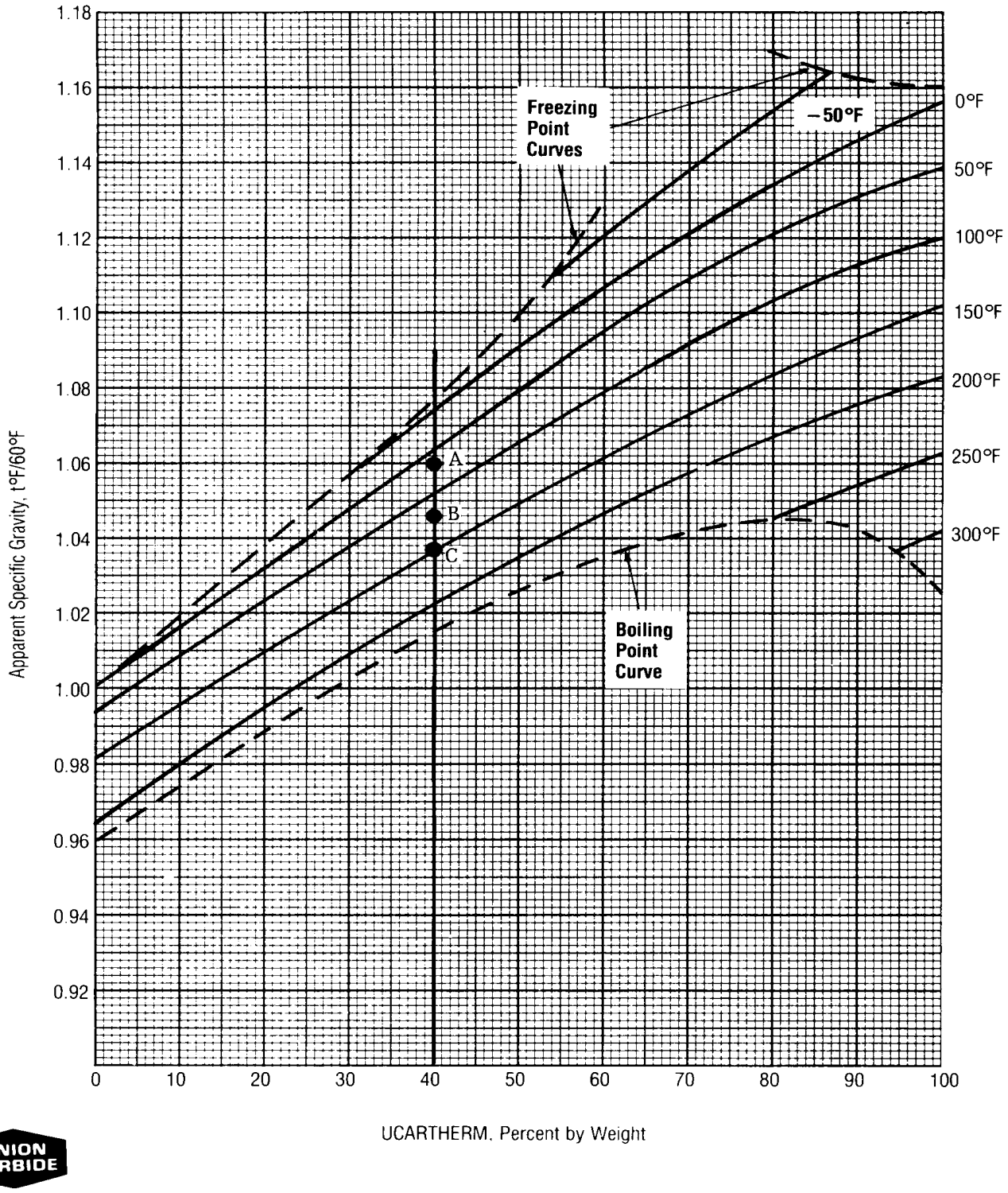

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Figure 3 • Boiling Points of UCARTHERM Heat Transfer Fluid

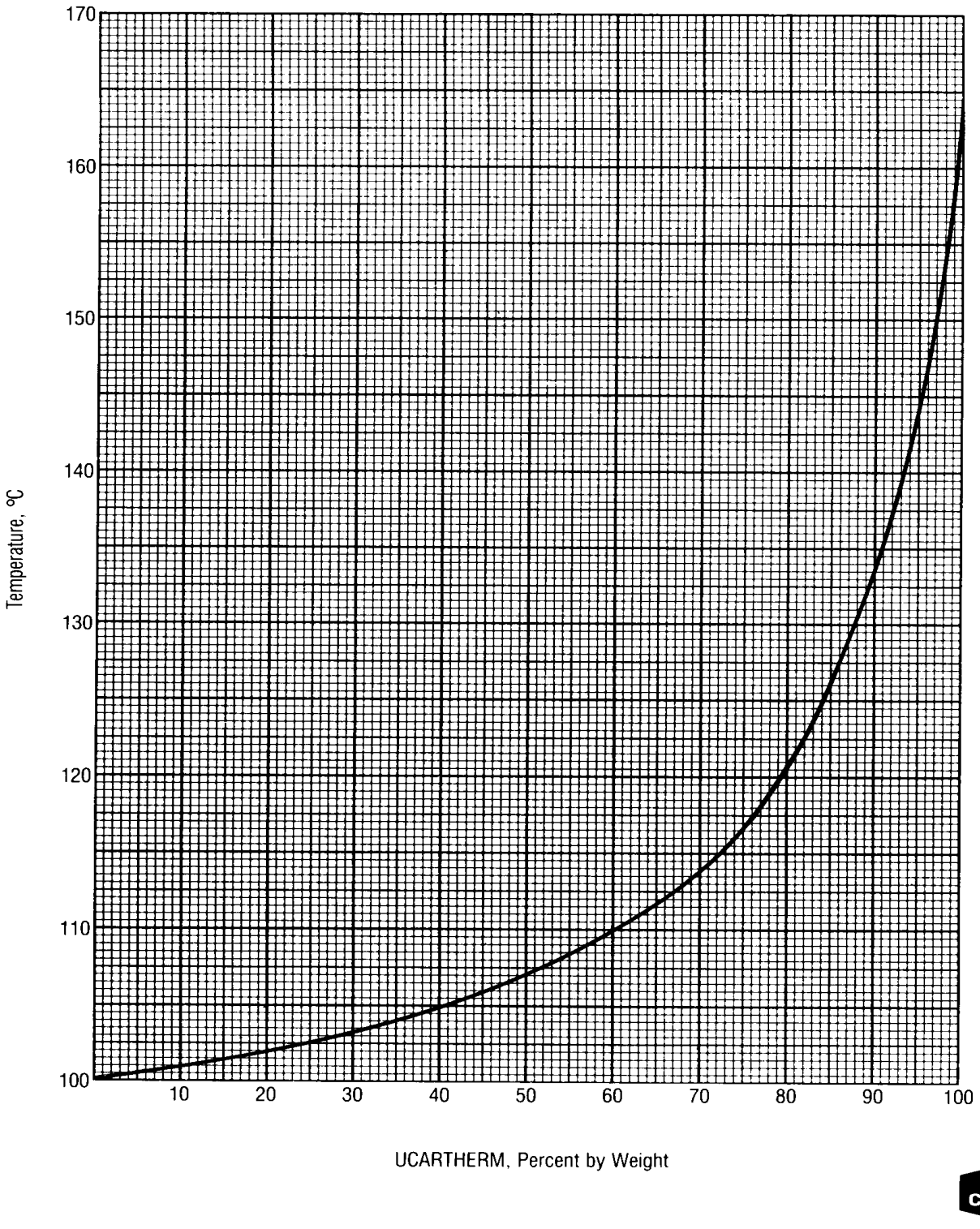

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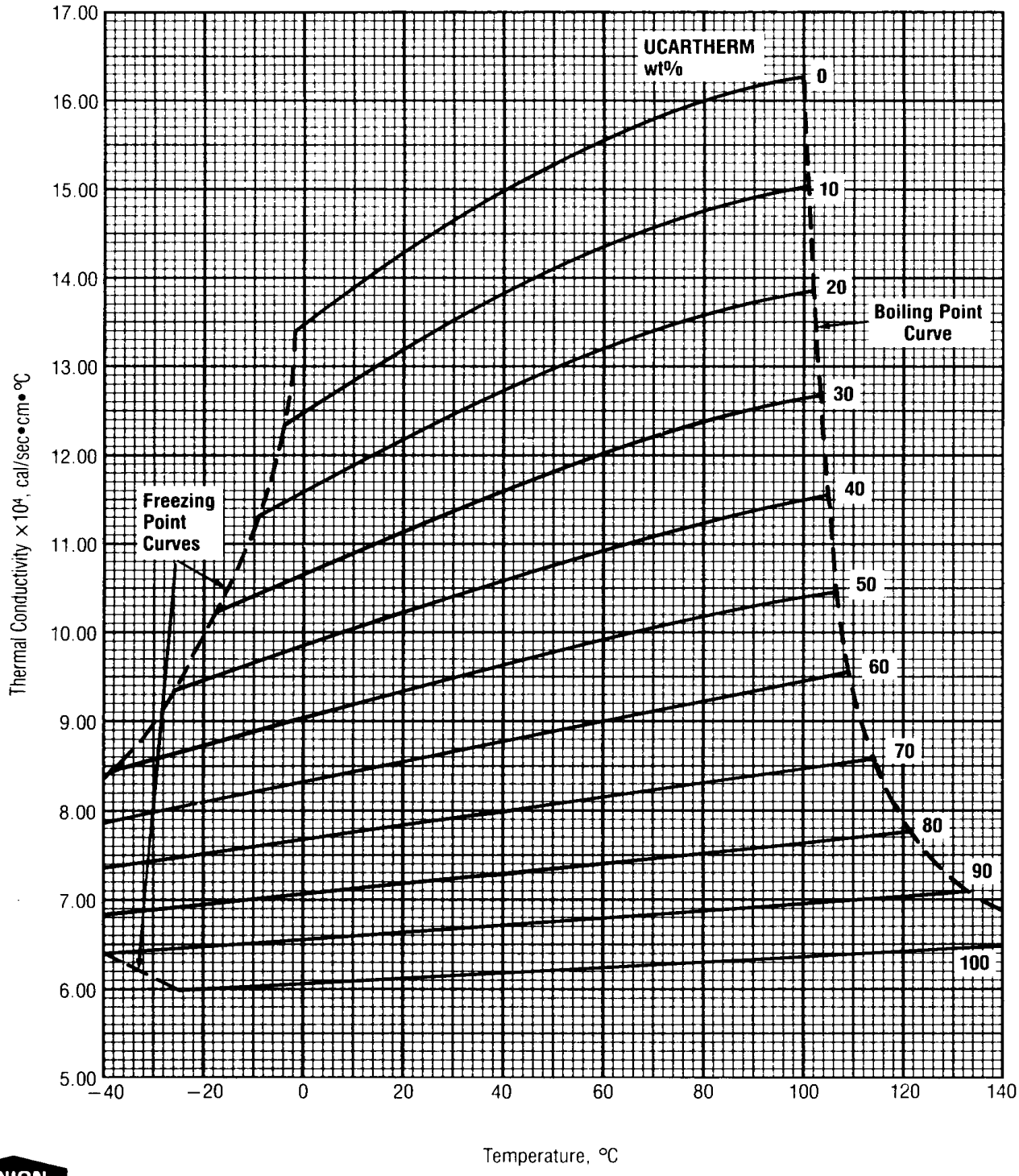
Figure 4 • Thermal Conductivity of Aqueous Solutions of UCARTHERM Heat Transfer Fluid



WARNING: Disconnect primary power prior to servicing.

Figure 5 • Specific Heats of UCARTHERM Heat Transfer Fluid

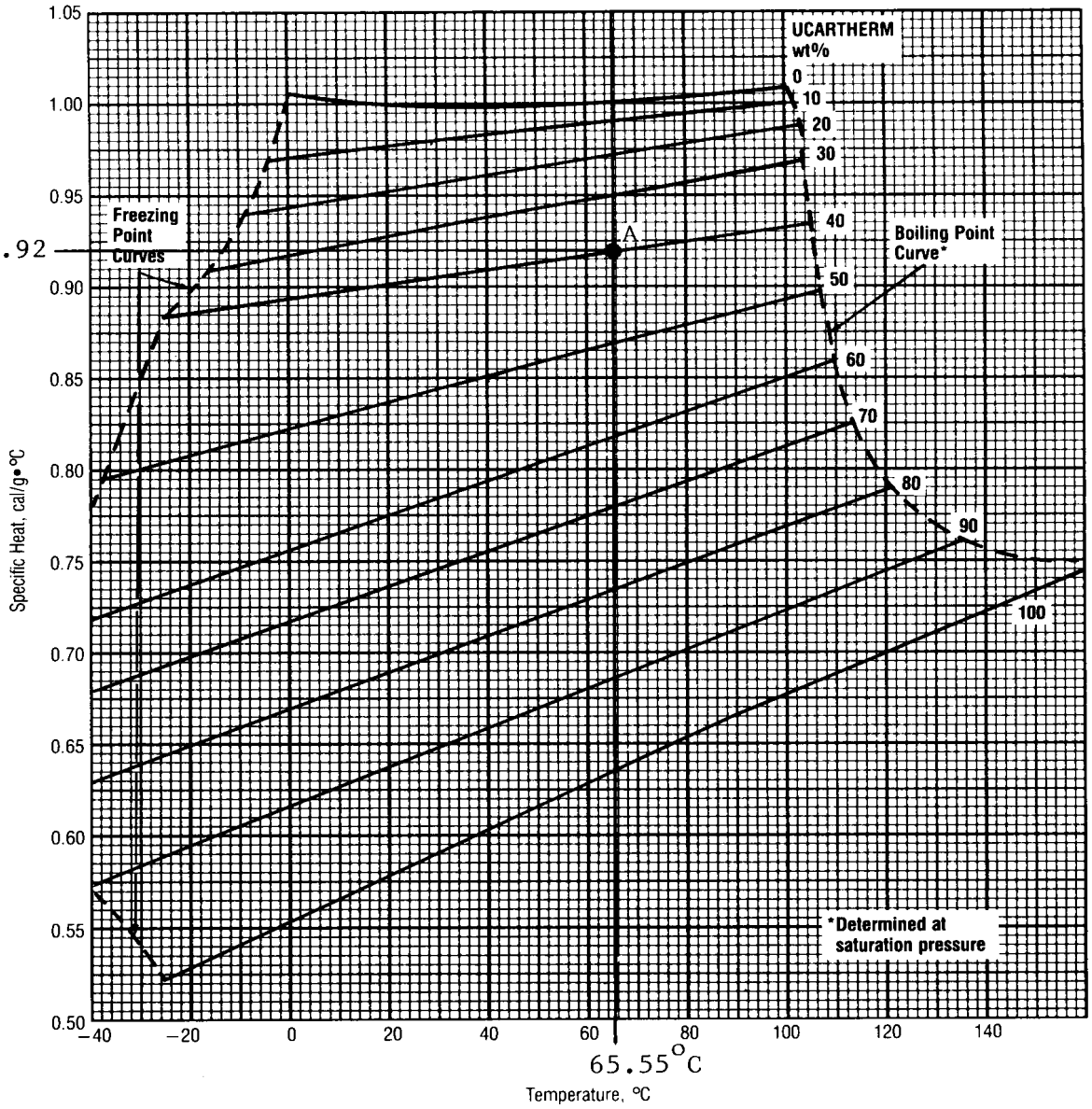


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Table 2
Shipping Data

Weight per U.S. Gallon	
at 20° C	9.43 lb
at 15.56 C	9.45 lb
Pounds per Gallon	0.00571 per
Coefficient of Expansion	
at 20 C	0.00061 per
at 55 C	0.00062 per
Flash Point	
Pensky-Martens Closed Cup (ASTM D 93)	127 C (260
Cleveland Open Cup (ASTM D 92)	129 C (265
Type Container and Net Contents	
1-Gallon Rectangular Tin Can	9.0 lb
5-Gallon DOT 17E Unlined Steel Pail	47 lb
55-Gallon DOT 17E Unlined Steel Drum	527 lb
DOT Label Required	None
DOT Shipping Name	None
DOT Hazard Classification	None
Re-Sample Time*, Months	15

*Re-Sample time is the maximum number of months a material may be stored in closed drums without re-sampling. It is an estimated value.

WARNING: Disconnect primary power prior to servicing.

Handling and Storage

ECOLOGICAL CONSIDERATIONS

UCARTHERM Heat Transfer Fluid has no known adverse effects on the enviroment. This product is readily biodegraded to carbon dioxide and water by aerobic microorganisms present in the natural environment or waste treatment systems. The total potential oxygen demand is about 1.3 pounds of oxygen per pound of product. Biodegradation studies on UCARTHERM indicate about 55 and 75 percent of this oxygen demand is exerted by Day 5 and Day 10 in the standard biochemical oxygen demand (BOD) test. The test method attempts to simulate the dilute bacterial concentrations of a river or lake. The much more concentrated biomass of a waste treatment system would be expected to remove this material in a matter of hours.

Even though this material is readily biodegradable, massive contamination of a water body could result in an oxygen demand that could not be satisfied by the natural reaeration process in an acceptable time period. In this event, a dissolved oxygen reduction will occur near the spill area, possibly producing fish kills and temporary anaerobic conditions.

UCARTHERM Heat Transfer Fluid is relatively nontoxic to aquatic life as indicated by the following acute toxicity test results. The 96-hour LC50 with fathead minnows is greater than 10,000 mg/L. Also, the 48-hour LC50 with Daphnia was measured as 7,360 mg/L.

Precautions to be Taken in Handling and Storage

Do not take internally.
Do not breathe mist from spray.
Avoid prolonged or repeated breathing of vapor.
Avoid contact with eyes.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.

FOR INDUSTRY USE ONLY.

Emergency Assistance

Assistance in any chemical emergency is as close as your nearest phone from Union Carbide's Hazardous Emergency Leak Procedures (HELP) and from Chemical Manufacturers Association (CHEMTREC).

Call HELP, collect:
(304) 744-3487
for any emergency involving a Union Carbide product
Call CHEMTREC, toll free:
(800) 424-9300
for any chemical emergency

UNION CARBIDE

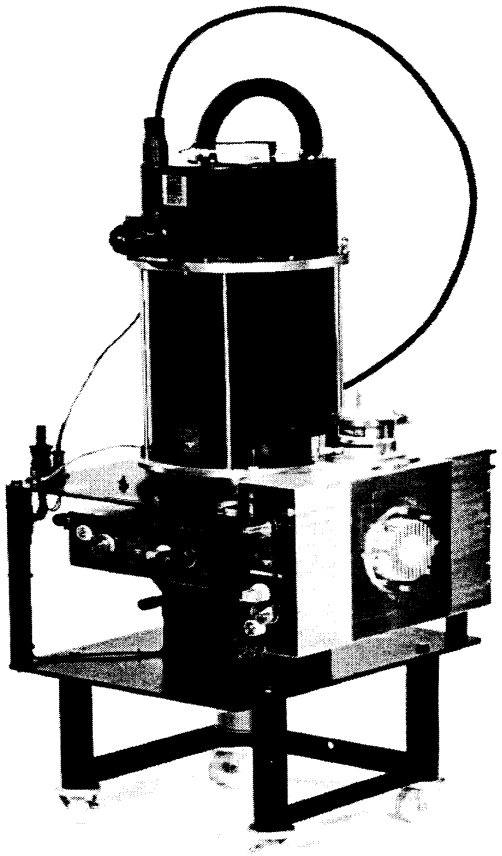
WARNING: Disconnect primary power prior to servicing.

IOT Amplifier
For Digital U.H.F. Television Service

IOTD2100 **EEV**

FEATURING

- **Frequency Range** 470 to 810 MHz (Bands IV and V) in a single tube and circuit.
- **Output Power** Rated as a digital amplifier for peak output powers from 77 kW to 110 kW peak and up to 30 kW average power.
- **Long Life** High reliability electron gun with barium aluminate cathode and pyrolytic graphite grid.
- **Simple, Efficient Cooling** Air-cooled cavities and gun. Water cooled body and collector.
- **Simple Tube Exchange** Continuously tunable external cavities, with digital frequency indicators. This means that a replacement tube will be coarse tuned on installation, needing only trimming adjustments.
- **Easy to Tune Input Cavity** Input cavity has a single tuning control. Frequency matching is achieved via a double slug tuner.
- **All Ceramics Aluminium Oxide** No beryllium oxide hazard.



IOTD2100

DIGITAL

DESCRIPTION

IOTD2100 is a high efficiency Inductive Output Tube amplifier for use in the output stage of digital transmitters in u.h.f. television service.

The IOT has an electro-magnetically focused electron beam which is density bunched using a rugged grid driven by an r.f. cavity. The IOT beam power varies with the depth of modulation.

The circuit assembly is designed to reduce tube replacement time to a minimum. The cavities can be detached from the vacuum tube and refitted on a replacement without disturbing the tuning, so that the replacement IOT is coarse tuned at switch-on and requires only trimming adjustments. A feature of the cavity design is that tuning of each cavity including the input cavity, is by means of a single knob. A digital indication of the cavity frequency is provided.

The electron gun and cavities require forced-air cooling; the circuit assembly incorporates a distribution manifold for which the cooling air must be adequately filtered to avoid electrostatic precipitation of dust on insulators.

The IOT body and collector are water cooled and the exit water must be led to a separate heat exchanger (not supplied).

Access to the high voltage electron gun connections of the IOT is via a removable lid on the top of the input cavity. The lid carries a high voltage warning label and the appropriate international symbol. The input cavity is fitted with a microswitch to enable the transmitter circuits to show that the lid is in place and secure. The transmitter can thus be fitted with an executive function to disconnect the high voltage power supply if the input cavity lid is not in place or properly secured.

EEV Inc

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A1A-IOTD2100 Issue 2, March 1997

WARNING: Disconnect primary power prior to servicing.

ABRIDGED DATA

Frequency range	470 to 810	MHz
Peak output power at IOT flange	77 to 110	kW
Average output power	up to 30	kW
Power gain (see note 1)	20 to 23	dB
Beam voltage	32 to 36	kV

GENERAL

Electrical

Cathode	indirectly heated	
Heater voltage (see note 2)	6.25 to 7.5	Vd.c.
Heater current range	20 to 30	A
Cathode pre-heating time	5	minutes
Ion pump to cathode voltage	+3.0 to 4.0	kV
Internal impedance of ion pump supply	500	kΩ approx

Mechanical

Overall length	80.5 cm (31.69 inches)	nom
Overall diameter	23.4 cm (9.21 inches)	nom
Mounting position	vertical, collector end down	
Net weight of IOT	29 kg (64 pounds)	approx

Circuit Assembly IMD2100A/B

Electro-magnet voltage	5.0 to 7.0	V
Electro-magnet current	22 to 26	A
R.F. input connector	type N coaxial (female)	
R.F. output	$3\,^1/_8$ inch 50 Ω coaxial line	
Net weight of tuning cavities	40 kg (88 pounds)	approx
Net weight of magnet assembly	113 kg (250 pounds)	approx

Cooling

Air flow to cavities and cathode terminal (see note 3)	2.0	m^3/min
	70.6	cfm
Static pressure head (see note 4)	1.27	kPa
	5	inches w.g.
Inlet air temperature	60	C max
Minimum water flow rate for body	4.0	l/min
	1.1	US gal/min
Body pressure drop at 4.0 l/min	21.1	kPa
	3	psi
Minimum water flow required for collector	38	l/min
	10	US gal/min
Collector pressure drop at 38 l/min	243	kPa
	35.2	psi
Inlet pressure	410	kPa max
	60	psi max
Water outlet temperature	70	C max
Water inlet temperature	50	C max

★ Indicates a change.

Tube Protection ★

Arc detector type MA257E is fitted to each of the primary and secondary output cavities. The beam voltage and drive power must be removed within 100 ms of an arc being detected. ★

Photo-resistor type	NSL 462	
Minimum dark resistance	20	MΩ
Resistance at 1 foot-candle	28	kΩ
Resistance at 100 foot-candles	600	Ω
Maximum voltage (peak)	70	V
Maximum temperature	75	°C
Layer	cadmium sulphide	
Test lamp	28	V
	0.04	A
Connections	see page 9	

MAXIMUM RATINGS (Absolute values)

The transmitter must be provided with a fast disconnect circuit which operates in the event of an internal arc (see note 5). If the maximum rating for any of the other parameters listed below is exceeded, the beam voltage must be removed within 100 ms from the instant at which the rating is exceeded. In either case, the beam voltage must not be re-applied within 5 seconds.

Heater starting current (peak)	60	A
Beam voltage (see note 6)	38	kV
Quiescent current	800	mA ★
Body current	50	mA
Collector dissipation	50	kW
Load v.s.w.r. (see note 7)	1.5:1	
Temperature of any part of tube envelope	130	°C
Peak drive power (see note 8)	1.1	kW
Average drive power	300	W
Grid to cathode bias voltage	−200	Vd.c.
Grid current	±150	mA
Ion pump current (beam on)	20	μA
Peak output power:		
at 36 kV	112	kW
at 34 kV	96	kW
at 32 kV	79	kW
Average output power	30	kW
X-ray radiation	2	μSv/hr ★
Altitude	3658	m ★
	12 000	ft

TYPICAL OPERATION

Digital Amplifier Service (See note 9)

Peak output power	77	94	110	kW
Average output power	20	24	28	kW
Peak input power	615	750	875	W
Average input power	155	190	220	W
Beam voltage	32	34	36	kV
Beam current (average)	1.4	1.6	1.8	A
Quiescent beam current	500	600	700	mA
Grid bias voltage with respect to cathode	see note 10			
Signal-to-noise degradation at a bit error rate of 10^{-4}	1.5	1.2	0.8	dB
Input sideband level	30	30	30	dB
Output sideband level	24	25	26	dB
Figure of Merit	172	173	170	%
Efficiency	43	45	41	% ★

WARNING: Disconnect primary power prior to servicing.

NOTES

1. The gain of the IOT is a frequency dependent function and follows the trend shown in Fig. 1 below. A double slug tuner is provided with the IOT input cavity to allow the drive power to be matched into the IOT assembly.

   The double slug tuner is supplied separately from the IOT input cavity, and should be installed between the transmitter circulator and the input cavity Heliax® cable.

   ® Registered trade mark.

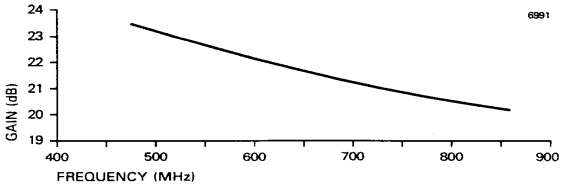


Fig. 1. IOTD2100 typical gain characteristic

2. **Heater Voltage**

   The actual heater voltage to be used on a particular IOTD2100 is advised with the tube, and should be set at the terminals of the junction box inside the IOT input cavity. The heater voltage should be stabilised to within ±0.15 V of the recommended value.

   Passive Standby and Quick-Start Modes

   Where an IOT is being used in a passive standby transmitter, several options exist for the mode of IOT passive operation:

   Background Heat Passive Standby Mode

   The IOTD2100 must be operated with a Background Heat filament voltage 1.5 V less than the nominal heater voltage advised on the test record for a particular IOT, and in no circumstances should the Background Heat heater voltage be less than 5.5 V.

   The Background Heat heater voltage should be measured at the terminals of the IOT input cavity junction box in the normal way.

   Passive standby is defined as any time period exceeding 30 minutes when the IOT is operated without beam voltage present but with the heater powered. The ion pump and all air cooling must be operated normally in this situation.

   If a passive standby transmitter is needed for transmission, the heater voltage should be raised to its rated value and other auxiliary supplies activated. Provided that the grid bias voltage is present, the beam voltage and r.f. drive may be applied to the tube simultaneously. Precautions must be taken to ensure that the IOT is not overdriven, for example by disabling the transmitter a.g.c. system for a period of about five minutes.

   Background heat must have been applied for at least 30 minutes from cold start before the transmitter can be considered available for transmission. Alternatively, both "Active" and "Standby" transmitters may be started from cold using the normal, 5-minute, start procedure. The "Standby" transmitter is then switched to Background Heat and is available to take over transmission if required.

★ Indicates a change.

Where Background Heat Passive Reserve is the normal operating mode with a pair of identical transmitters, the transmitter designated as "Standby" must become the "Active" transmitter after a period not exceeding 14 days and must remain designated "Active" for a period of not less than 7 days.

If a hydrogen thyratron crowbar is used in the "Standby" transmitter it should be permanently powered to full operational status.

Filament hours accumulated under Background Heat conditions do not count as warranty hours, provided that the above conditions are met and that there are proper means to distinguish Background Heat hours from normal heater hours.

Soft Start

It is recommended that a soft start procedure should be used in the application of the r.f. drive when the IOT is powered either from cold or from background heat.

The r.f. drive may be applied simultaneously with the ★ beam voltage and with a typical rise time of 4 seconds.

Near-instantaneous Start - Quiescent Passive Standby

A nearly instantaneous start from standby can be achieved by operating the "Standby" transmitter in a quiescent passive standby mode where the r.f. drive only is removed from the IOT and the tube operates with the normal beam voltage applied. The tube draws a quiescent current (which may be lower than the normal value). This slightly reduces overall system efficiency, but ensures that the standby tube is maintained in good condition and is available for near-instant start, subject to normal soft start conditions.

The minimum quiescent current that should be used in this mode is 100 mA. This will ensure the tube maintains ★ a good vacuum and life in standby mode.

Alternatively, the quiescent current may be maintained at the normal operational level, with no adverse effects to the IOT, but with slightly reduced overall system efficiency resulting from greater standby power dissipation.

Mains Interruptions

If mains power is absent for a time less than or equal to 15 seconds, then the transmitter may be re-powered immediately provided that the transmitter logic is active and the power supplies are therefore re-applied in the correct order.

If mains power is absent for a time between 15 seconds and five minutes, then heater voltage should be re-applied for a time equal to the mains absence time before attempting to re-power the IOT, which should then be powered in the normal way.

If mains power is absent for a time in excess of five minutes, then normal cold start-up procedures should be followed.

3. This value applies to transmitters at sea level where the air density is 1.22 kg/m^3 (0.076 lb/ft^3). At high altitudes where the air density is significantly reduced the volume flow must be increased in the ratio of air density at sea level to air density at altitude in order to maintain the mass flow.
4. Measured by a manometer at the input pipe to the circuit assembly.

WARNING: Disconnect primary power prior to servicing.

5. A fast disconnect system capable of protecting a 300 mm length of thin copper wire at all voltages above 5 kV must be provided. Suitable wire sizes are detailed below and any of those listed may be used. The test simulates a d.c. arc inside the IOT vacuum envelope. EEV is able to provide thyratron crowbar equipment specially designed for use with the IOT. Details will be provided upon request.

Test Wire Sizes

Standard wire gauge (SWG)	Conductor diameter (mm)	Total diameter (inc. enamel)
40	0.1219	0.155
American wire gauge (AWG)	**Conductor diameter (mm)**	**Total diameter (inc. enamel)**
37	0.1143	0.1475
36	0.127	0.16

6. The high voltage power supply must be designed and connected to the IOT at start-up in such a way that high voltage overshoots are minimised and do not exceed the stated maximum.
7. Typical operating performance will be obtained for a load v.s.w.r. of less than 1.1:1. The tube will not sustain damage for a load v.s.w.r. of less than 1.5:1.
8. Protection circuits in the transmitter must ensure that it is not possible for r.f. drive power to be applied to the IOT in the absence of beam voltage. Failure to do so may result in serious damage to the IOT.
9. IOTD2100 can amplify either European system (OFDM) or US system (8-VSB) signals. The values given are for a 64 QAM, 2000-carrier multiplex OFDM signal with no spectral holes and a raw data rate of 24.13 Mbit/s.

   For OFDM transmission using 16 QAM, an improvement in the signal-to-noise ratio of approximately 6 dB at a bit error rate of 10^{-4} can be expected.

   For transmission of an 8-VSB signal, results similar to those for the 64 QAM OFDM may be expected.
10. Grid bias should be provided by a regulated power supply, adjustable over the range 50 to 150 V, negative with respect to cathode voltage. Adjust to provide the required quiescent current. The supply should be able to sink or source grid current.

INTELLECTUAL PROPERTY RIGHTS

This product is subject to one or more of the following U.S. patents and corresponding patents in other countries:

US5548245 US5239272 US5536992

HEALTH AND SAFETY HAZARDS

High power IOTs can be hazardous to life and health if they are not installed, operated and maintained correctly, or if an IOT is damaged. EEV does not accept responsibility for damage or injury resulting from the use of EEV IOTs. Equipment manufacturers and IOT users should ensure that precautions are taken. Appropriate warning labels and notices must be provided on equipment incorporating IOTs and in operating manuals.

High Voltage

Equipment must be designed so that operators cannot come into contact with high voltage circuits. IOT enclosures should have fail-safe interlocked switches to disconnect the primary power supply and discharge all high voltage capacitors before allowing access.

R.F. Radiation

Personnel must not be exposed to excessive r.f. radiation. All r.f. connectors and cavities must be correctly fitted before operation, so that there is no leakage of r.f. energy. IOTs must not be operated without a suitable r.f. load at the output and intermediate cavities. It is particularly dangerous to look into open waveguide or coaxial feeders, or transmitter antennae.

X-Ray Radiation

All high voltage devices produce X-rays during operation and may require shielding. When EEV IOTs are operated normally with the r.f. cavities fitted, some protection is provided but further shielding may be required. A suitably designed equipment cabinet will provide sufficient additional shielding. However, it is strongly recommended that all complete equipments containing operating IOT systems should be measured to establish that external X-ray levels comply with local regulations.

Mechanical

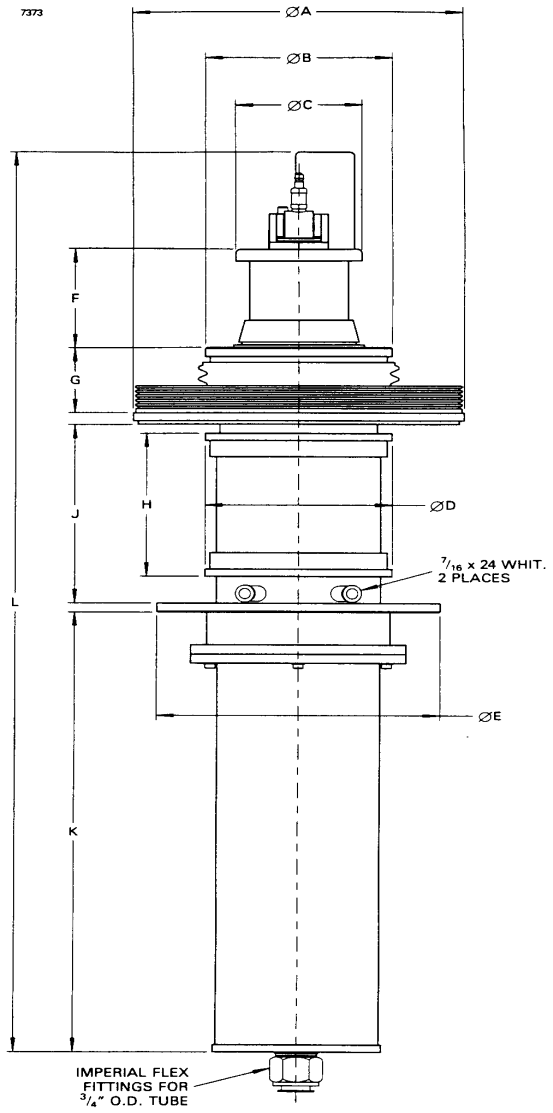
The circuit assembly has been designed to occupy the minimum of floor space in the transmitter. The wheel base is, therefore, short in relation to the height of the assembly, which has a high centre of gravity. Care is required when wheeling the magnet frame, and in particular, the IOT assembled in the magnet frame, over uneven surfaces or gradients which could cause the assembly to overbalance.

Hot Surfaces

Surfaces of tubes (for example the tube envelope in the gun region and the collector manifold in an air-cooled tube) can reach high temperatures (in some cases in excess of 100 °C) during operation and may remain at a high temperature for a considerable time after switch-off. Burns may be sustained if direct contact is made with hot surfaces.

WARNING: Disconnect primary power prior to servicing.

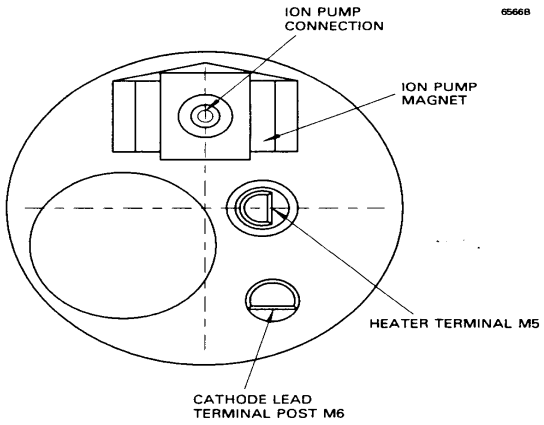
OUTLINE OF IOTD2100 (All dimensions without limits are nominal)



Ref	Millimetres	Inches
A	230.4	9.071
B	130.05 ± 0.30	5.120 ± 0.012
C	93.0	3.661
D	130.05 ± 0.30	5.120 ± 0.012
E	197.15	7.762
F	87.5	3.445
G	58.25	2.293
H	127.0	5.000
J	158.7	6.248
K	385.5	15.177
L	792.5	31.201

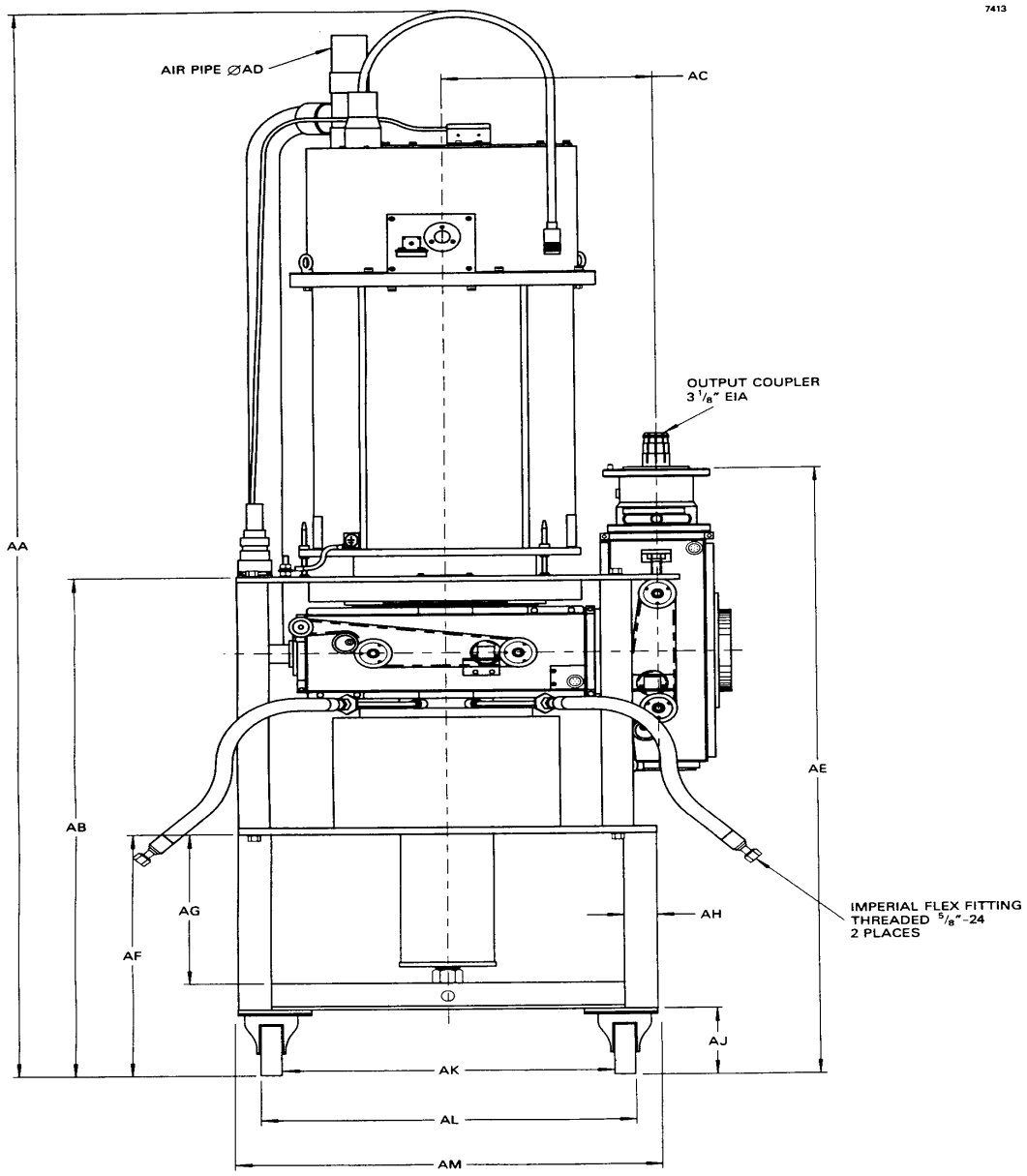
Inch dimensions have been derived from millimetres.

Enlarged View of Gun End of Tube

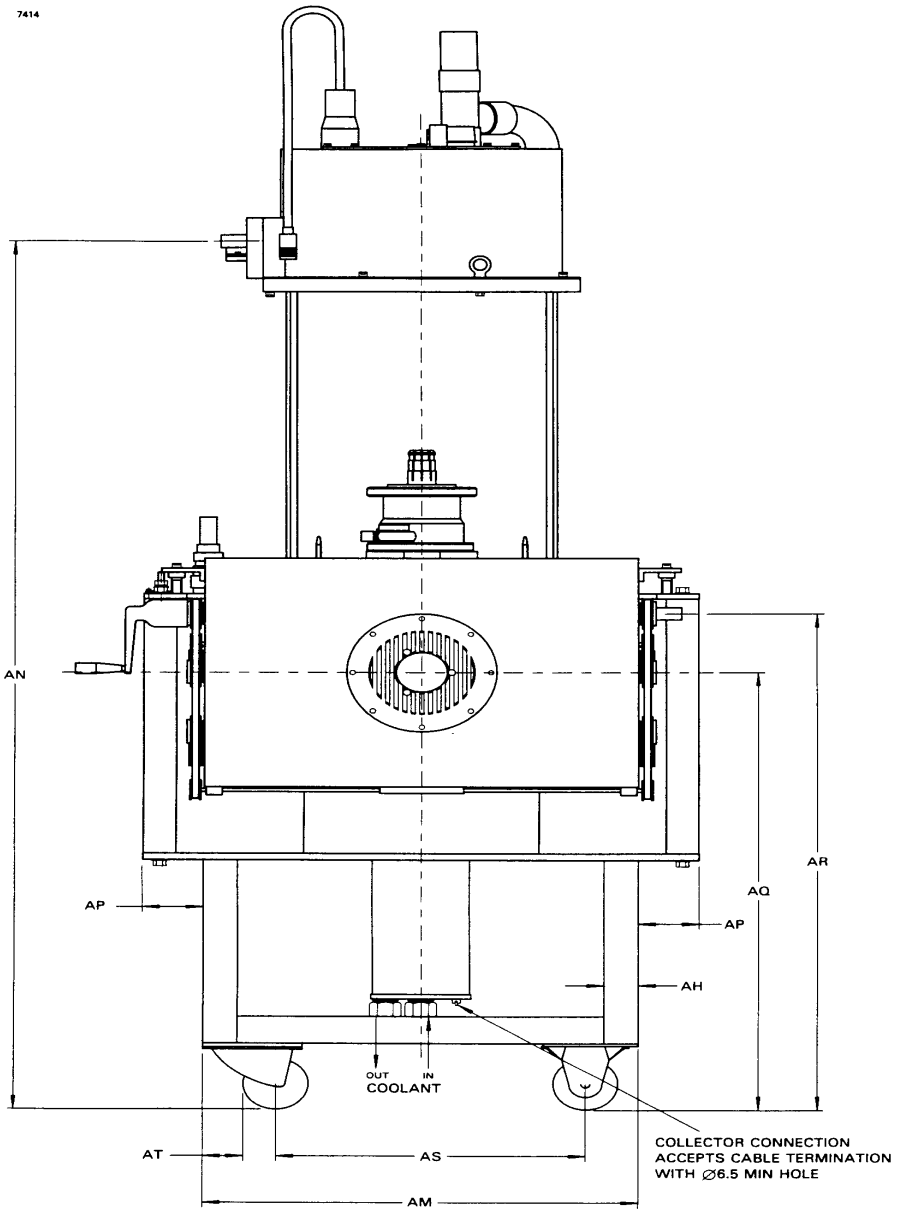


WARNING: Disconnect primary power prior to servicing.

OUTLINE OF CIRCUIT ASSEMBLY IMD2100A/B (All dimensions without limits are nominal)

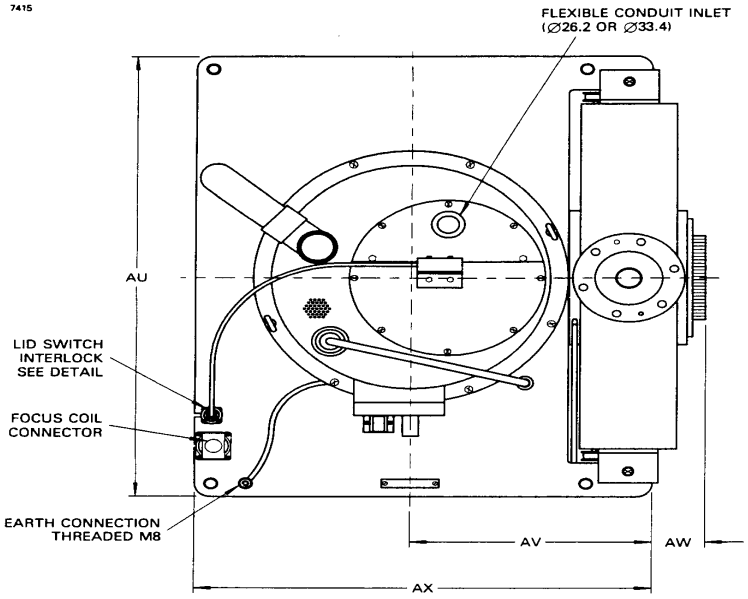


WARNING: Disconnect primary power prior to servicing.



WARNING: Disconnect primary power prior to servicing.

TOP VIEW OF CIRCUIT ASSEMBLY (All dimensions nominal)

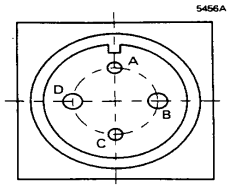


Ref	Millimetres	Inches
AA	1730.0 max	68.110 max
AB	766.0	30.157
AC	258.4	10.173
AD	42.5	1.673
AE	923.2	36.346
AF	370.0	14.567
AG	230.0	9.055
AH	40.0	1.575
AJ	100.0	3.937
AK	403.4	15.882
AL	453.4	17.850
AM	508.0	20.000
AN	1288.47	50.727
AP	71.0	2.795
AQ	648.8	25.543
AR	736.8	29.008
AS	400.0	15.748
AT	25.8	1.016
AU	650.0	25.591
AV	285.0	11.220
AW	62.0	2.441
AX	539.0	21.220

Inch dimensions have been derived from millimetres.

WARNING: Disconnect primary power prior to servicing.

View on Focus Coil Connector



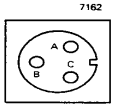
Connections

Pin	Element
A	Lid switch
B	Focus coil positive
C	Lid switch
D	Focus coil negative

Pins A and C are connected within the circuit assembly for use as an interlock circuit; this connection may be removed by the customer if required for other purposes.

Lid Switch Interlock

Connections

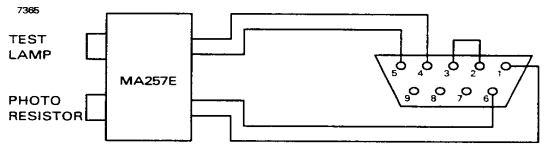


Pin	Connection
A	Lid switch
B	Lid switch
C	Not connected

The lid switch is connected between pins A and C of the focus coil connector socket. The lid switch contacts are rated at 480 V a.c. or 28 V d.c. at 15 A.

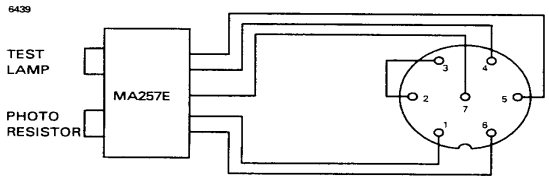
Arc Detector Connections to D-type socket MA2666A/B ★

MA257E uses a panel plug and free socket.



Arc Detector Connections to socket type Amphenol T3476-001

MA257E uses a panel plug and free socket.



RECOMMENDED COOLANTS

Where there is no possibility of freezing, the coolant should be good quality demineralised water. Where outside temperatures are such that pure water will freeze, then the coolant should be a mixture of equal volumes of pure demineralised water and a commercial glycol containing appropriate inhibitors and pH buffers. The concentration of glycol may be reduced in accordance with the manufacturer's instructions depending on the minimum temperature at which protection is required. When using a glycol coolant, the coolant flow rate will need to be increased to compensate for the change in heat capacity of the mixture. As an example, for a 50/50 water/glycol mixture, the flow per unit time should be increased by 14% to maintain adequate cooling.

Glycol antifreeze mixtures are prone to thermal degradation with life, especially where the coolant is oxygenated. Consequently, return pipes should discharge below the level of the coolant in reservoir tanks to minimise oxygen take-up. Coolants such as Dowtherm SR1 and Dowcal 10 have been examined by EEV, and are believed to contain suitable pH buffers and inhibitors to make them suitable for IOT cooling.

It is recommended that the coolant is discarded after being used for one winter season to prevent the possibility of corrosion damage occurring. The transmitter should then be operated with demineralised water during the summer before being replaced by a fresh glycol mixture before the onset of the following winter.

The use of unbuffered and uninhibited ethylene glycol will lead to corrosion damage to both the cooling system and the IOT and should not be used except in an emergency, where such use should not exceed one week.

STARTING THE TRANSMITTER AT VERY LOW AMBIENT TEMPERATURES

At very low coolant temperatures, around −20 °C (−4 °F), the ability of glycol/water mixtures to remove heat is severely reduced. Before powering the IOT at full beam power, the coolant should be at a temperature of at least 5 °C (41 °F). Therefore, at lower temperatures it should be prewarmed by running the IOT on idle current only or by any other appropriate means. For example, allowing the coolant to circulate all night during periods of very low ambient temperature may maintain the coolant temperature around 5 °C, due to the dissipation of the energy consumed by the circulating pump, provided that the cooling fan on the heat exchanger is turned off.

★ Indicates a change.

Whilst EEV has taken care to ensure the accuracy of the information contained herein it accepts no responsibility for the consequences of any use thereof and also reserves the right to change the specification of goods without notice. EEV accepts no liability beyond that set out in its standard conditions of sale in respect of infringement of third party patents arising from the use of tubes or other devices in accordance with information contained herein.

WARNING: Disconnect primary power prior to servicing.

IOT Amplifier
For Digital U.H.F. Television Service

IOTD270 **EEV**

FEATURING

- **Frequency Range** 470 to 810 MHz (Bands IV and V) in a single tube and circuit.
- **Output Power** Rated as a digital amplifier for peak output powers from 45 kW to 75 kW peak and up to 19 kW average power.
- **Long Life** High reliability electron gun with barium aluminate cathode and pyrolytic graphite grid.
- **Simple, Efficient Cooling** Air-cooled cavities and gun. Water cooled body and collector.
- **Simple Tube Exchange** Continuously tunable external cavities, with digital frequency indicators. This means that a replacement tube will be coarse tuned on installation, needing only trimming adjustments.
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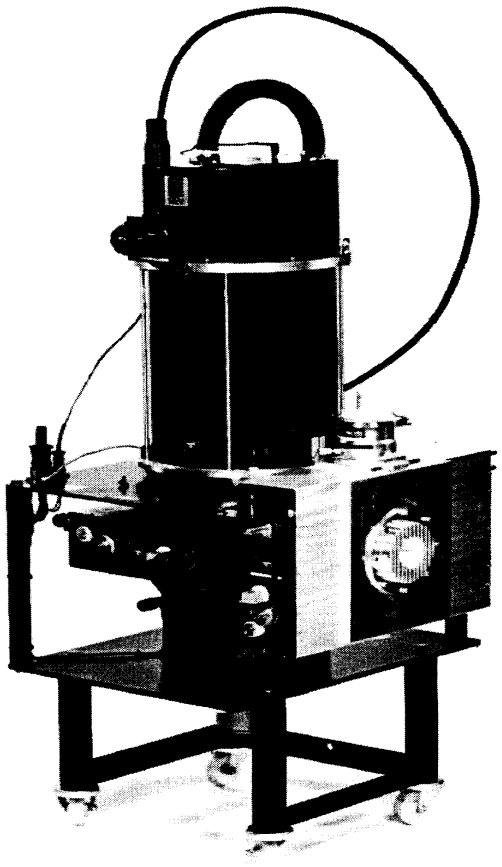
- **All Ceramics Aluminium Oxide** No beryllium oxide hazard.



IOTD270

DIGITAL

DESCRIPTION

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Access to the high voltage electron gun connections of the IOT is via a removable lid on the top of the input cavity. The lid carries a high voltage warning label and the appropriate international symbol. The input cavity is fitted with a microswitch to enable the transmitter circuits to show that the lid is in place and secure. The transmitter can thus be fitted with an executive function to disconnect the high voltage power supply if the input cavity lid is not in place or properly secured.

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A1A-IOTD270 Issue 1, March 1997

WARNING: Disconnect primary power prior to servicing.

ABRIDGED DATA

requency range	470 to 810	MHz
eak output power at IOT flange	45 to 75	kW
verage output power	up to 19	kW
ower gain (see note 1)	20 to 23	dB
eam voltage	30 to 32	kV

ENERAL

lectrical

athode	indirectly heated	
eater voltage (see note 2)	6.25 to 7.5	Vd.c.
eater current range	20 to 30	A
athode pre-heating time	5	minutes
n pump to cathode voltage	+3.0 to 4.0	kV
ternal impedance of ion pump supply	500	kΩ approx

lechanical

verall length	75.8 cm (29.85 inches)	nom
verall diameter	23.4 cm (9.21 inches)	nom
ounting position	vertical, collector end down	
et weight of IOT	22 kg (50 pounds)	approx

ircuit Assembly IMD270

ectro-magnet voltage	5.0 to 7.0	V
ectro-magnet current	22 to 26	A
F. input connector	type N coaxial (male)	
F. output	$3\,^1/_8$ inch 50 Ω coaxial line	
et weight of tuning cavities	40 kg (88 pounds)	approx
et weight of magnet assembly	113 kg (250 pounds)	approx

ooling

r flow to cavities and cathode terminal (see note 3)	2.0	m^3/min
	70.6	cfm
atic pressure head (see note 4)	1.27	kPa
	5	inches w.g.
let air temperature	60	°C max
inimum water flow rate for body	4.0	l/min
	1.1	US gal/min
ody pressure drop at 4.0 l/min	21.1	kPa
	3	psi
inimum water flow required for collector	38	l/min
	10	US gal/min
ollector pressure drop at 38 l/min	63	kPa
	9.1	psi
et pressure	410	kPa max
	60	psi max
ater outlet temperature	70	°C max
ater inlet temperature	50	°C max

Tube Protection

Arc detector type MA257E is fitted to each of the primary and secondary output cavities. The beam voltage and drive power must be removed within 100 ms of an arc being detected.

Photo-resistor type	NSL 462	
Minimum dark resistance	20	MΩ
Resistance at 1 foot-candle	28	kΩ
Resistance at 100 foot-candles	600	Ω
Maximum voltage (peak)	70	V
Maximum temperature	75	°C
Layer	cadmium sulphide	
Test lamp	28	V
	0.04	A
Connections	see page 9	

MAXIMUM RATINGS (Absolute values)

The transmitter must be provided with a fast disconnect circuit which operates in the event of an internal arc (see note 5). If the maximum rating for any of the other parameters listed below is exceeded, the beam voltage must be removed within 100 ms from the instant at which the rating is exceeded. In either case, the beam voltage must not be re-applied within 5 seconds.

Heater starting current (peak)	60	A
Beam voltage (see note 6)	35	kV
Quiescent current	800	mA
Body current	50	mA
Collector dissipation	50	kW
Load v.s.w.r. (see note 7)	1.5:1	
Temperature of any part of tube envelope	130	°C
Peak drive power (see note 8)	750	W
Average drive power	200	W
Grid to cathode bias voltage	−200	Vd.c.
Grid current	±150	mA
Ion pump current (beam on)	20	μA
Peak output power	78	kW
Average output power	20	kW
X-ray radiation	2	μSv/hr
Altitude	3658	m
	12 000	ft

TYPICAL OPERATION

Digital Amplifier Service

Peak output power	45	75	kW
Average output power	11.3	19	kW
Beam voltage	28	32	kV
Beam current	1.0	1.3	A
Grid bias voltage with respect to cathode	see note 9		
Peak drive power	400	640	W
Average drive power	100	160	W

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NOTES

1. The gain of the IOT is a frequency dependent function and follows the trend shown in Fig. 1 below. A double slug tuner is provided with the IOT input cavity to allow the drive power to be matched into the IOT assembly.

   The double slug tuner is supplied separately from the IOT input cavity, and should be installed between the transmitter circulator and the input cavity Heliax® cable.

   ® Registered trade mark.

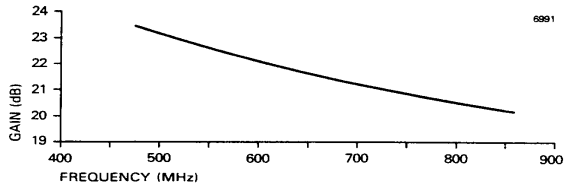

Fig. 1. IOTD270 typical gain characteristic

2. **Heater Voltage**

   The actual heater voltage to be used on a particular IOTD270 is advised with the tube, and should be set at the terminals of the junction box inside the IOT input cavity. The heater voltage should be stabilised to within ±0.15 V of the recommended value.

   Passive Standby and Quick-Start Modes

   Where an IOT is being used in a passive standby transmitter, several options exist for the mode of IOT passive operation:

   Background Heat Passive Standby Mode

   The IOTD270 must be operated with a Background Heat filament voltage 1.5 V less than the nominal heater voltage advised on the test record for a particular IOT, and in no circumstances should the Background Heat heater voltage be less than 5.5 V.

   The Background Heat heater voltage should be measured at the terminals of the IOT input cavity junction box in the normal way.

   Passive standby is defined as any time period exceeding 30 minutes when the IOT is operated without beam voltage present but with the heater powered. The ion pump and all air cooling must be operated normally in this situation.

   If a passive standby transmitter is needed for transmission, the heater voltage should be raised to its rated value and other auxiliary supplies activated. Provided that the grid bias voltage is present, the beam voltage and r.f. drive may be applied to the tube simultaneously. Precautions must be taken to ensure that the IOT is not overdriven, for example by disabling the transmitter a.g.c. system for a period of about five minutes.

   Background heat must have been applied for at least 30 minutes from cold start before the transmitter can be considered available for transmission. Alternatively, both "Active" and "Standby" transmitters may be started from cold using the normal, 5-minute, start procedure. The "Standby" transmitter is then switched to Background Heat and is available to take over transmission if required.

   Where Background Heat Passive Reserve is the normal operating mode with a pair of identical transmitters, the transmitter designated as "Standby" must become the "Active" transmitter after a period not exceeding 14 days and must remain designated "Active" for a period of not less than 7 days.

   If a hydrogen thyratron crowbar is used in the "Standby" transmitter it should be permanently powered to full operational status.

   Filament hours accumulated under Background Heat conditions do not count as warranty hours, provided that the above conditions are met and that there are proper means to distinguish Background Heat hours from normal heater hours.

   Soft Start

   It is recommended that a soft start procedure should be used in the application of the r.f. drive when the IOT is powered either from cold or from background heat.

   The r.f. drive may be applied simultaneously with the beam voltage and with a typical rise time of 4 seconds.

   Near-instantaneous Start - Quiescent Passive Standby

   A nearly instantaneous start from standby can be achieved by operating the "Standby" transmitter in a quiescent passive standby mode where the r.f. drive only is removed from the IOT and the tube operates with the normal beam voltage applied. The tube draws a quiescent current (which may be lower than the normal value). This slightly reduces overall system efficiency, but ensures that the standby tube is maintained in good condition and is available for near-instant start, subject to normal soft start conditions.

   The minimum quiescent current that should be used in this mode is 100 mA. This will ensure the tube maintains a good vacuum and life in standby mode.

   Alternatively, the quiescent current may be maintained at the normal operational level, with no adverse effects to the IOT, but with slightly reduced overall system efficiency resulting from greater standby power dissipation.

   Mains Interruptions

   If mains power is absent for a time less than or equal to 15 seconds, then the transmitter may be re-powered immediately provided that the transmitter logic is active and the power supplies are therefore re-applied in the correct order.

   If mains power is absent for a time between 15 seconds and five minutes, then heater voltage should be re-applied for a time equal to the mains absence time before attempting to re-power the IOT, which should then be powered in the normal way.

   If mains power is absent for a time in excess of five minutes, then normal cold start-up procedures should be followed.

3. This value applies to transmitters at sea level where the air density is 1.22 kg/m^3 (0.076 lb/ft^3). At high altitudes where the air density is significantly reduced the volume flow must be increased in the ratio of air density at sea level to air density at altitude in order to maintain the mass flow.

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4. Measured by a manometer at the input pipe to the circuit assembly.
5. A fast disconnect system capable of protecting a 300 mm length of thin copper wire at all voltages above 5 kV must be provided. Suitable wire sizes are detailed below and any of those listed may be used. The test simulates a d.c. arc inside the IOT vacuum envelope. EEV is able to provide thyratron crowbar equipment specially designed for use with the IOT. Details will be provided upon request.

Test Wire Sizes

Standard wire gauge (SWG)	Conductor diameter (mm)	Total diameter (inc. enamel)
40	0.1219	0.155
American wire gauge (AWG)	**Conductor diameter (mm)**	**Total diameter (inc. enamel)**
37	0.1143	0.1475
36	0.127	0.16

6. The high voltage power supply must be designed and connected to the IOT at start-up in such a way that high voltage overshoots are minimised and do not exceed the stated maximum.
7. Typical operating performance will be obtained for a load v.s.w.r. of less than 1.1:1. The tube will not sustain damage for a load v.s.w.r. of less than 1.5:1.
8. Protection circuits in the transmitter must ensure that it is not possible for r.f. drive power to be applied to the IOT in the absence of beam voltage. Failure to do so may result in serious damage to the IOT.
9. Grid bias should be provided by a regulated power supply, adjustable over the range 50 to 150 V, negative with respect to cathode voltage. Adjust to provide the required quiescent current. The supply should be able to sink or source grid current.

INTELLECTUAL PROPERTY RIGHTS

This product is subject to one or more of the following U.S. patents and corresponding patents in other countries:

US5548245 US5239272 US5536992

HEALTH AND SAFETY HAZARDS

High power IOTs can be hazardous to life and health if they are not installed, operated and maintained correctly, or if an IOT is damaged. EEV does not accept responsibility for damage or injury resulting from the use of EEV IOTs. Equipment manufacturers and IOT users should ensure that precautions are taken. Appropriate warning labels and notices must be provided on equipment incorporating IOTs and in operating manuals.

High Voltage

Equipment must be designed so that operators cannot come into contact with high voltage circuits. IOT enclosures should have fail-safe interlocked switches to disconnect the primary power supply and discharge all high voltage capacitors before allowing access.

R.F. Radiation

Personnel must not be exposed to excessive r.f. radiation. All r.f. connectors and cavities must be correctly fitted before operation, so that there is no leakage of r.f. energy. IOTs must not be operated without a suitable r.f. load at the output and intermediate cavities. It is particularly dangerous to look into open waveguide or coaxial feeders, or transmitter antennae.

X-Ray Radiation

All high voltage devices produce X-rays during operation and may require shielding. When EEV IOTs are operated normally with the r.f. cavities fitted, some protection is provided but further shielding may be required. A suitably designed equipment cabinet will provide sufficient additional shielding. However, it is strongly recommended that all complete equipments containing operating IOT systems should be measured to establish that external X-ray levels comply with local regulations.

Mechanical

The circuit assembly has been designed to occupy the minimum of floor space in the transmitter. The wheel base is, therefore, short in relation to the height of the assembly, which has a high centre of gravity. Care is required when wheeling the magnet frame, and in particular, the IOT assembled in the magnet frame, over uneven surfaces or gradients which could cause the assembly to overbalance.

Hot Surfaces

Surfaces of tubes (for example the tube envelope in the gun region and the collector manifold in an air-cooled tube) can reach high temperatures (in some cases in excess of 100 °C) during operation and may remain at a high temperature for a considerable time after switch-off. Burns may be sustained if direct contact is made with hot surfaces.

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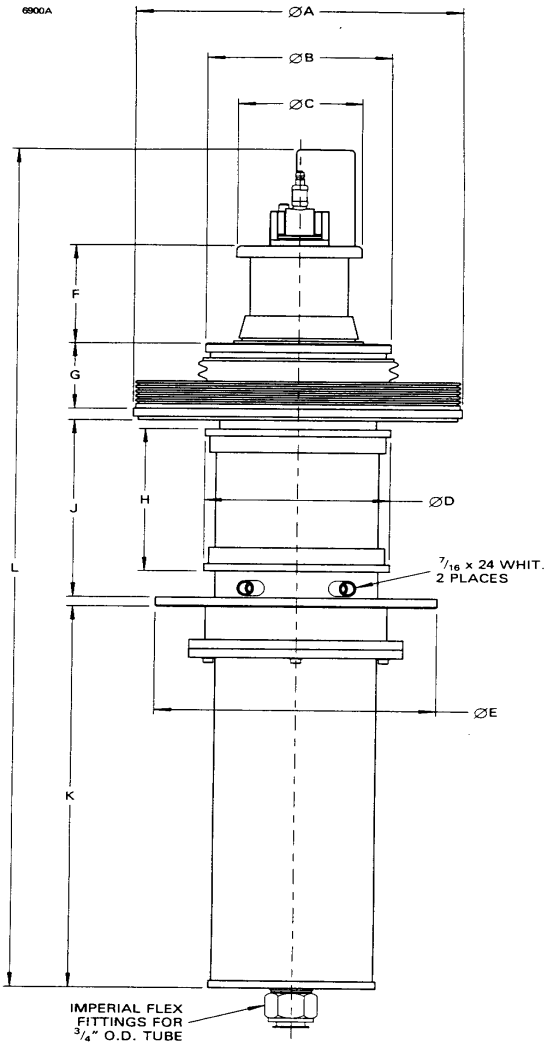
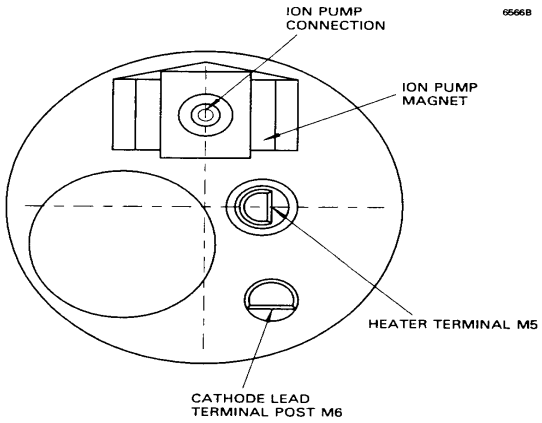
OUTLINE OF IOTD270 (All dimensions without limits are nominal)



Ref	Millimetres	Inches
A	230.4	9.071
B	130.05 ± 0.30	5.120 ± 0.012
C	93.0	3.661
D	130.05 ± 0.30	5.120 ± 0.012
E	197.15	7.762
F	87.5	3.445
G	58.25	2.293
H	127.0	5.000
J	158.7	6.248
K	335.48	13.208
L	742.5	29.232

Inch dimensions have been derived from millimetres.

Enlarged View of Gun End of Tube



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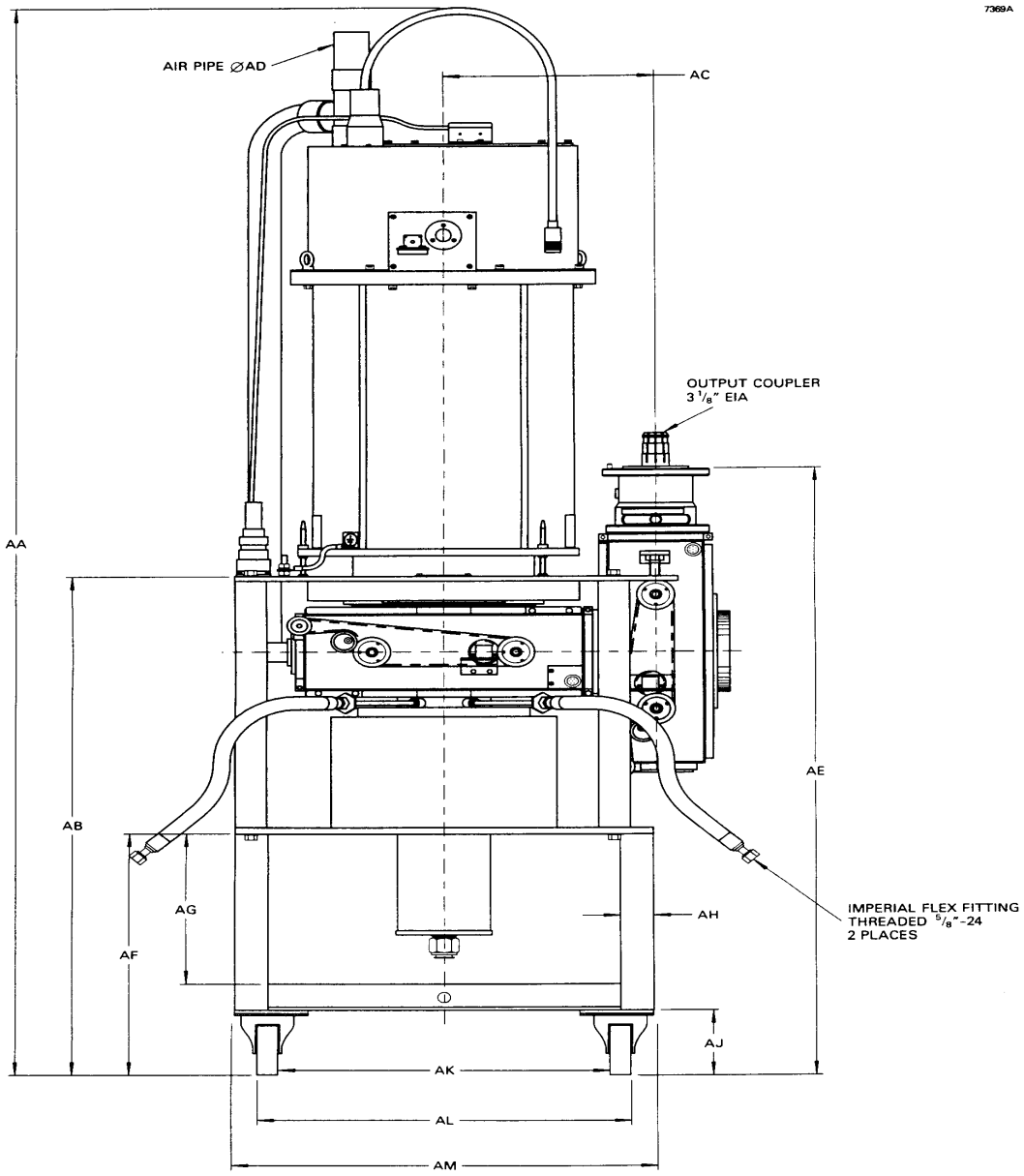
OUTLINE OF CIRCUIT ASSEMBLY IMD270 (All dimensions without limits are nominal)



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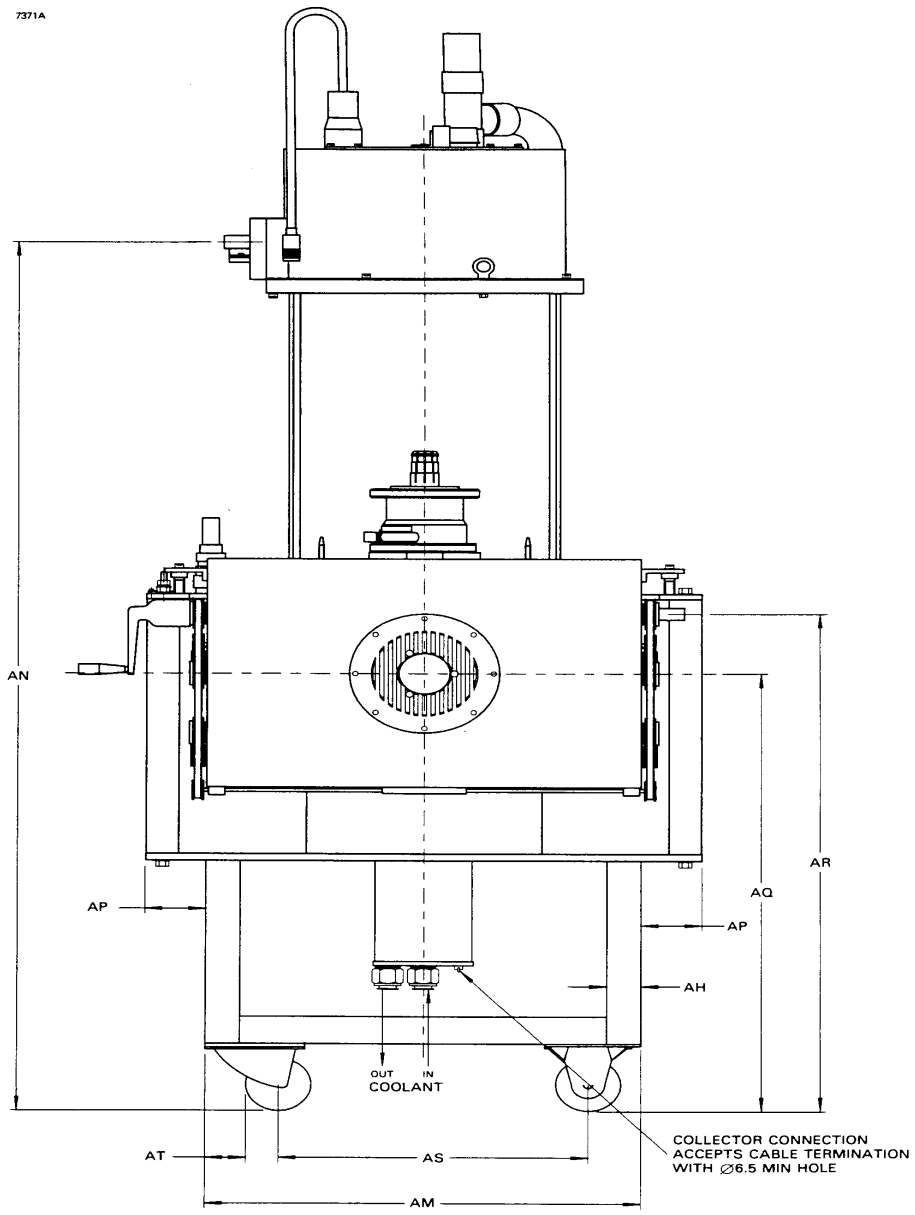

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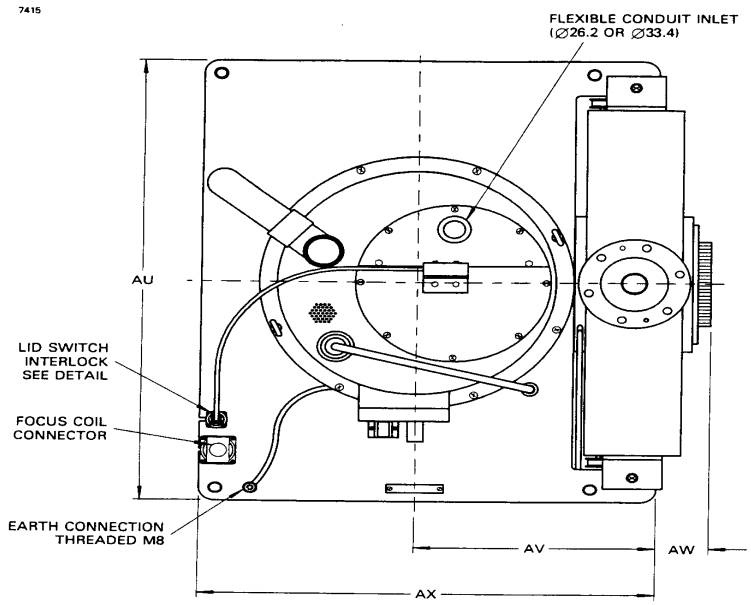
TOP VIEW OF CIRCUIT ASSEMBLY (All dimensions nominal)



Ref	Millimetres	Inches
AA	1730.0 max	68.110 max
AB	766.0	30.157
AC	258.4	10.173
AD	42.5	1.673
AE	923.2	36.346
AF	370.0	14.567
AG	230.0	9.055
AH	40.0	1.575
AJ	100.0	3.937
AK	403.4	15.882
AL	453.4	17.850
AM	508.0	20.000
AN	1288.47	50.727
AP	71.0	2.795
AQ	648.8	25.543
AR	736.8	29.008
AS	400.0	15.748
AT	25.8	1.016
AU	650.0	25.591
AV	285.0	11.220
AW	62.0	2.441
AX	539.0	21.220

Inch dimensions have been derived from millimetres.

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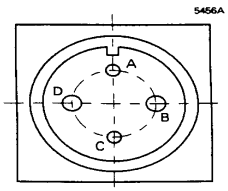
View on Focus Coil Connector



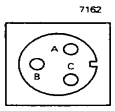
Connections

Pin	Element
A	Lid switch
B	Focus coil positive
C	Lid switch
D	Focus coil negative

Pins A and C are connected within the circuit assembly for use as an interlock circuit; this connection may be removed by the customer if required for other purposes.

Lid Switch Interlock

Connections

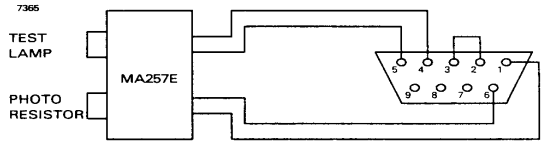


Pin	Connection
A	Lid switch
B	Lid switch
C	Not connected

The lid switch is connected between pins A and C of the focus coil connector socket. The lid switch contacts are rated at 480 V a.c. or 28 V d.c. at 15 A.

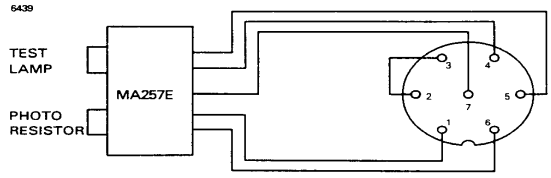
Arc Detector Connections to D-type socket MA2666A/B

MA257E uses a panel plug and free socket.



Arc Detector Connections to socket type Amphenol T3476-001

MA257E uses a panel plug and free socket.



RECOMMENDED COOLANTS

Where there is no possibility of freezing, the coolant should be good quality demineralised water. Where outside temperatures are such that pure water will freeze, then the coolant should be a mixture of equal volumes of pure demineralised water and a commercial glycol containing appropriate inhibitors and pH buffers. The concentration of glycol may be reduced in accordance with the manufacturer's instructions depending on the minimum temperature at which protection is required. When using a glycol coolant, the coolant flow rate will need to be increased to compensate for the change in heat capacity of the mixture. As an example, for a 50/50 water/glycol mixture, the flow per unit time should be increased by 14% to maintain adequate cooling.

Glycol antifreeze mixtures are prone to thermal degradation with life, especially where the coolant is oxygenated. Consequently, return pipes should discharge below the level of the coolant in reservoir tanks to minimise oxygen take-up. Coolants such as Dowtherm SR1 and Dowcal 10 have been examined by EEV, and are believed to contain suitable pH buffers and inhibitors to make them suitable for IOT cooling.

It is recommended that the coolant is discarded after being used for one winter season to prevent the possibility of corrosion damage occurring. The transmitter should then be operated with demineralised water during the summer before being replaced by a fresh glycol mixture before the onset of the following winter.

The use of unbuffered and uninhibited ethylene glycol will lead to corrosion damage to both the cooling system and the IOT and should not be used except in an emergency, where such use should not exceed one week.

STARTING THE TRANSMITTER AT VERY LOW AMBIENT TEMPERATURES

At very low coolant temperatures, around −20 °C (−4 °F), the ability of glycol/water mixtures to remove heat is severely reduced. Before powering the IOT at full beam power, the coolant should be at a temperature of at least 5 °C (41 °F). Therefore, at lower temperatures it should be prewarmed by running the IOT on idle current only or by any other appropriate means. For example, allowing the coolant to circulate all night during periods of very low ambient temperature may maintain the coolant temperature around 5 °C, due to the dissipation of the energy consumed by the circulating pump, provided that the cooling fan on the heat exchanger is turned off.

Whilst EEV has taken care to ensure the accuracy of the information contained herein it accepts no responsibility for the consequences of any use thereof and also reserves the right to change the specification of goods without notice. EEV accepts no liability beyond that set out in its standard conditions of sale in respect of infringement of third party patents arising from the use of tubes or other devices in accordance with information contained herein.

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Appendix G
Beam Supply

IOT BROADCAST BEAM SUPPLY - 736 0269 000

HARRIS P/N	*DESCRIPTION*	*QTY/UM*	*REF. SYSMBOL/EXPLANATIONS*
510 0748 000 . .	CAPACITOR, 30 UF, 660 VAC.	3	C1,2,3
560 0081 000 . .	MOV, 575 VRMS	3	MOV 1,2,3
560 0099 000 . .	CAP-MOV ASSY	1	N/A
384 0945 000 . .	TRANS-PACK, FULL WAVE BRIDGE		
. . . . .	6 ADC, 90KPIV W/RC NETWORK . .	1	1REC
418 0039 000 . .	BUSHING 18 KV CLASS 110A	3	N/A
418 0040 000 . .	L.V. BUSHING, 400AAC	3	N/A
359 1041 000 . .	PRESSURE RELIEF VALVE	1	N/A
359 0979 000 . .	LIQUID LEVEL GAUGE	1	N/A
442 0104 000 . .	TEMPERATURE GAUGE	1	N/A
560 0098 000 . .	SURGE ARRESTOR..6 KV.	1	MOV 4
358 2870 000 . .	COVER CLAMPS	36	N/A
510 0755 000 . .	CAPACITOR, 4UF, 40KV	2	C4,5
542 1627 000 . .	.RESISTOR, 20 OHM, 225 WATTS .	2	R1,2
540 1541 000 . .	RESISTOR, 40 OHM, 75WATT	2	R3,4
604 1164 000 . .	.INTLK SW: JB COVER	1	N/A
604 1165 000 . .	INTLK SW: TAP SW COVER	1	N/A
604 1166 000 . .	INTLK SW: SHRTG STICK.	1	N/A

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